ROADS AND STREETS

Vol. LXX APRIL, 1930 No. 4

Sunday Traffic at Kaign Avenue Circle, Camden, N. J.

Is the Toll Road a Solution?

Will the Changing Conditions of Traffic and Resulting Congestion Bring Toll Roads into General Use?

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THE establishment of toll charges for the use of a road from Syria to Babylon about 2,000 B. C. was probably the earliest toll highway. Shortly after the French revolution, Napoleon raised funds for the construction and maintenance of roads by the collection of tolls and during his regime France made notable progress in the development of a system of National Highways. The excellent road system existing throughout the United Kingdom was established as a result of the activities of turnpike trusts, which were authorized to build roads and bridges and collect tolls for their use. By 1835 in the United Kingdom nearly 22,000 miles of road construction had been authorized through the passage of 3,800 turnpike acts. In numerous other countries the principle of financing roads by toll collections has been practiced.

The First Toll Roads in the United States.—The history of toll roads in the United States began about 1785, at which time the legislatures of Connecticut, Maryland and Virginia authorized the collection of tolls to repair and maintain certain existing roads. By 1793 tolls were being charged on the road from Alexandria to Georgetown in Virginia, on the Old Post Road near Greenwich in Connecticut, on the road from Norwich to New London, Connecticut, and on the road from Baltimore to Reisterstown in Maryland. These roads were operated by state authorities.

The first privately owned toll road, of which there is a record in the United States, was the Lancaster Turnpike from Philadelphia to Lancaster, Pa., which was also the first macadam road to be built in the United States. It was constructed at a cost of $465,000, and was completed in the year 1796. This road was 62 miles long and had nine stations at which tolls were collected. The Philadelphia and Lancaster Turnpike Road Company continued in operation until 1902. The Little River Turnpike Company rebuilt a road from Little River to Alexandria, Virginia, which was finally completed in 1805, and was continued as a toll road until 1896. During the nineteenth century toll roads continued to gain in favor in this country and in England and reports show that 56 companies were incorporated in Connecticut, 67 in New York, and many others in the states

Toll Gate at Eastern Terminus of Long Island Motor Parkway

of Massachusetts, New Jersey, Pennsylvania, Maryland and Virginia.

These toll roads prospered in varying degrees, but declined in earning power with the advent of modern railway transportation service and eventually were generally taken over by states or counties. The obsolescence of the toll road would have continued except for the coming into general use of the automobile which caused a demand for more and better highway facilities. The Federal Government, the individual states, and their political subdivisions, have endeavored to construct toll free highways suitable to serve the demands of modern traffic, and in doing this are spending in excess of a billion dollars a year for road construction and maintenance. The gasoline tax, which in certain states is now as high as 5¼ ct. per gallon is one of the principal sources of funds for this work. Notwithstanding large bond issues and gasoline and license taxes, the supply of funds for road construction is insufficient and it is evident to the everyday automobile driver, that the highway systems existing have failed to keep pace with the demands of motor traffic, and day by day, in or adjacent to centers of population, the highways are becoming more congested.

$600,000,000 Invested in Toll Bridges.—In order to relieve the congestion at river crossings there have been constructed and are in operation 292 toll bridges in the United States and on the international boundaries, some of them costing a number of millions of dollars. At present there is invested in toll bridges some $600,000,000 of private capital and with few exceptions this investment is yielding a satisfactory and adequate return to the investor.

It would appear to one who studies the traffic problem, that it is probable that toll roads will be constructed to relieve traffic conditions, just as toll bridges have been constructed to relieve conditions at river crossings. It is also to be remarked that the pioneers in the construction of toll bridges have in most cases been well rewarded for the original investments made. It would seem that in many cases the abandoned right-of-way of canals, or street railways could be utilized in the construction of toll roads.

The "Autostrada" of Italy.—A system of toll highways without grade crossings has been assured for the motorists of Italy. A good portion of this system of "Autostrada," as the roads are designated, has already been built and other links are under construction. Mussolini recently signed a measure creating a body to have supervision of 15,000 miles of the "Autostrada." Through this toll system and method of semi-public control, Italy is getting highway benefits which could be obtained in no other way. The Italian highway requirement and the requirements of other countries are so great that private capital was necessarily called into use.

Toll Highways in the United States.—In the United States recently there have been constructed certain toll highways extending to points of interest, such as the Pike's Peak Toll Road in Colorado, Great Falls Toll Road in Virginia, Medina Highway Toll Road in Texas, Mt. Mitchell Toll Road in North Carolina. However, there is only one toll road of any extent existing in the United States which is actually built to serve the needs of motor traffic by relieving congested conditions and that is the Long Island Motor Parkway extending through the central portion of Long Island.

The Long Island Motor Parkway was built in 1908 as a portion of an automobile racing course on which the Vanderbilt Cup Races were held. The Parkway has cost to date an amount exceeding $6,000,000. The road surface is of macadam, varies in width from 16 to 18 ft. and provides for two traffic lanes. The Parkway traverses a congested section in the central portion of Long Island and all grade crossings have been eliminated. By using this highway the motorist is enabled, particularly on Sundays and holidays, to escape annoying delays due to cross road traffic. The Parkway is subjected to very considerable competition in the form of free nearby public highways paralleling it. The Motor Parkway, however, is carrying a very substantial traffic and it is reported that for the past five years there has been an annual increase in this traffic of 25 per cent. The construction of competing roads instead of influencing traffic adversely has often been noted to cause an increase in the traffic on the Parkway because there is a stimulation of vehicular traffic in the general vicinity. This road serves the purpose of taking motorists from the congested district adjacent to Flushing, Long Island, to Lake Ron-

Traffic Congestion on the White Horse Pike

konkama, which is in the middle of Long Island.

Proposed Super-Highways.—There is being much thought given at the present time to plans for the construction of a series of super-highways traversing the congested portions of the United States. A joint resolution was introduced in Congress last year creating a commission to study proposals for a National System of Express Motorways, this commission to be known as the United States Motorways Commission and to be composed of two members of the Senate appointed by the President, two members of the House appointed by the President, and seven other individuals, one representing the Department of Agriculture, one the Department of Commerce, one the Post Office Department, one the Department of War, one the Department of Labor, one the Treasury Department, and one appointed from outside the Government. This Commission would be authorized and directed to make a study of the proposal for the establishment of a National System of Express Motorways with a view to making recommendations to Congress with respect to the establishment and maintenance of such a system. The expenditure of necessary funds to carry on the work of this Commission is authorized in the bill. The Express Motorways, which it is proposed to construct, are 42 in number and connect the principal centers of population in the United States. One of these highways extends from New York to San Francisco and the other highways are mainly in the regions of congested traffic in the northeast and central portions of the United States.

The Need for Super-Highways.—There exists today a number of broad, smooth, permanently paved highways in the United States. However, in many cases they go through the heart of busy cities, intersecting cross roads and cross railroads at grade. Therefore they are not as efficient as they could be as they do not permit an uninterrupted flow of traffic for any great distance. Traffic moves along these highways at a good speed for some five or ten miles, then when the highway enters a congested area there is a considerable delay encountered, particularly on Sundays and holidays. Automibiles have been vastly improved in the past decade, they are dependable, powerful and capable of speeds of sixty, seventy and even eighty miles an hour and yet these speeds can only be used at very infrequent periods and short distances because the development of our highways has not kept pace with the developments in motor transport. It would therefore appear, to one who considers these matters carefully, that there is a need for the construction of a series of super or express highways.

Clover Leaf Intersection Near Woodbridge, N. J. This was Constructed to Provide Free Traffic Flow at Intersection of Two of New Jersey's Most Heavily Traveled State Highways

Engineering Council Appoints Airport Committee

Appointment of an airport committee to work with the federal government is announced by the American Engineering Council. The chairman is Prof. Ralph J. Fogg, head of the Department of Civil Engineering in Lehigh University. Other members are:

Perry A. Fellows, City Engineer, Detroit; W. W. Horner, Chief Engineer, St. Louis; Harrison E. Howe, Editor, "Industrial and Engineering Chemistry," Washington; Alexander Klemin, head of the Guggenheim School of Aeronautics, New York University; H. G. Shirley, State Commissioner of Highways, Richmond, Va.

"The committee," the announcement says, "has been appointed to confer with the Bureau of Aeronautics of the Department of Commerce for the purpose of developing a plan whereby the bureau and the American Engineering Council may co-operate in formulating a report for the information and guidance of public bodies indicating the diversity and and importance of engineering problems in the design of airports."

The committee was named upon the recommendation of a special committee of which O. H. Koch of Dallas, Tex., was chairman. Other members of the special committee were John Lyle Harrington of Kansas City, Mo.; General R. C. Marshall, Jr., of Chicago; George T. Seabury of New York, secretary of the American Society of Civil Engineers, and Dr. Howe.

Dr. Howe, who is chairman of the Council's Committee on Program of Research, states in a report to the Council that the Bureau of Aeronautics has asked the Council to join with it in making a study of relating to the coverage and drainage used for airports. The need for such a study was apparent Dr. Howe says, because there was no uniformity of practice, no central source of information as to what had been used and the results obtained.

He points out that a report on what practices were prevailing under various conditions of terrain, climate and the like would be a valuable guide to engineers responsible for the construction of airports.

Census of City Trees

The city of Syracuse, N. Y., is believed to be the first municipality to undertake a comprehensive tree census. The work is being done under the direction of City Forester A. Robert Thompson. The system is known as the black-card system and was modeled closely after one recommended for the city of New York by Professor Laurie D. Cox, head of the Department of City Forestry at the New York State College of Forestry, Syracuse University.

The census shows the city street in which every tree grows, the block number, terminal streets, number of trees for the block, planting specifications and whether planting is advisable, recommendations for handling existing trees, whether the block is a unit of a major or minor street in the city street system. Each tree is numbered and described, together with the width and parking strip on the street and distance of trees from curb.

The census cards were made out by students of the New York State College of Forestry and required a period of ten weeks at a cost of $.016 per tree. Fifty-three thousand, three hundred and eighty-six trees were recorded, with American elm, sugar maple, silver maple and Norway maple, predominating. Whenever work is done or required to be done in connection with any tree the fact is noted on the cards so the census is continuous and always up to date. Any street tree in the city can be located immediately by the census records and accurate information obtained concerning it.

The Oil Mix Method in Missouri

Procedure of the State Highway Commission in Its Work During 1929

By A. A. STRANE

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THE Missouri State Highway Commission has been experimenting for the past three years with two distinct types of bituminous ing delegated to the individual munictreatments for utilizing existing gravel and stone bases. The two types were copied largely from methods developed in Indiana and from methods developed in the western states, more particularly in California. The underlying theory of the two types of construction vary greatly.

The method developed in Indiana is most commonly known as the "Retread" method. The aggregates used in the construction of retread are extremely coarse, and the resulting surface is open. In this method large aggregate is used, and if a treatment 2 in. in depth is desired, aggregates may be used as large as that passing a 2½-in. screen. The California system of oil-sand mix calls for aggregates similar to those used in sheet asphalt construction; the ideal specification even specifies a considerable percentage passing a 200 mesh screen.

As a general rule the retread method, using coarse crushed aggregate and either refined tar or cut-back asphalt, seems to meet all conditions better in Missouri than the other type. However, in certain sections of the state we have a large supply of fine aggregates that is not suitable for any other use except the oil mix method, and consequently in these sections the oil mix treatments can be used at a considerable saving over the retread method. The oil mix method consists simply in mixing in place fine aggregates and certain grades of 65 to 85 per cent asphaltic residual road oil.

The oil mix method is more simple to perform insofar as the actual manipulation is concerned, but it is much more difficult to write a definite formula or specification to be followed. The various quantities of aggregate and bituminous material used must be varied to meet the existing conditions. Much depends upon the judgment of the engineer in the field, and his judgment depends largely upon previous experience in handling similar materials. In our original work we had for a guide only the book put out by the California State Highway Department and the Bureau of Public Roads, outlining the methods and specifications covering aggregates and bituminous materials, together with a few pictures of stain tests taken of successful jobs in California. We made stain tests in an effort to determine whether or not we had sufficient quantity of bituminous material, and compared these with the photographs. An excess of bituminous material causes the surface to shove under traffic and a deficiency causes the surface to ravel. Therefore, the field engineer through experience and observation must learn the proportions to use.

In the oil mix, it has been our experience that the percentage of oil by weight will vary considerably, depending upon the nature or amount of fines in the aggregate used. Roughly, the percentage will be between 4½ per cent for a relatively coarse aggregate and up to 12 per cent for an exceptionally fine aggregate.

In our experimental work on oil mixes, we have used nothing but fine materials, such as soft ground Joplin chat, Iron Mountain chat, and crushed Dolomite. The latter material is very fine, but rather uniform in size, and does not contain an appreciable amount of 200 mesh material. However, by placing the material on the road and allowing traffic to use it for a period, enough fine material is ground up to obtain the desired results.

Construction Methods.—During 1929 we used the following procedure in our oil mix work:

Chat hauling was done by contract in advance of the construction of the surface. Approximately 17 yd. of chats per station were dumped from trucks in a uniform windrow on one side of the roadway, so as not to interfere with traffic. Care was taken to insure a uniform size of windrow at all points. The half of the road opposite the windrow was bladed until smooth. An asphaltic oil primer of 12-18 viscosity at 140° F. was then applied to this half of the road at the rate of ¼ gal. per square yard. After the primer had cured for a day, the windrow of chat was moved to the other side of the road, and the remaining half was bladed and primed. The chat windrow was then moved to the center of the road and leveled down until approximately 10 ft. in width.

The oil was applied over that surface in applications of not less than ¼ gal. per square yard each, figured over the full width of the roadway. This made a 950 gal. load run approximately 1,700 ft.; thus providing long sections for the equipment used in mixing. The chat and oil were thoroughly disked following each application; two or three round trips being made with the disk between loads. When five applications had been made on one section and disking completed, a heavy tractor and 12-ft. blade started mixing. After another section had been treated with oil and disked, it was added to the section on which the grading outfit was working. As sections were mixed to a uniform color with graders, the mixed material was windrowed in the center of the road, to be spread later. Spreading was done in sections 2 miles in length. In some places it was necessary to add more oil to bring the mix to the required richness, a lean condition being noted by means of stain tests made after the final mixing. The average amount of oil used over a 4-mile section was 1.4 gal. per square yard, and the average amount of chat was approximately 210 lbs. per square yard, which is equivalent to 5½ per cent of oil by weight exclusive of primer.

After the mixture was spread uniformly over the surface, traffic was turned onto the road to aid in compacting the material. No rolling was done, as it has been found that traffic compacts the surfacing material better than it can be done with rollers. The surface was continuously bladed with motor patrol graders during the time required for the mixture to become solid and firm. The blading was usually continued for three days and produced a riding surface of unusual smoothness.

Costs.—The cost of oil mix has been less than 25 ct. per square yard for a 2½-in. compacted surface. Some of the cost has been as low as 19 ct. per square yard where suitable aggregates were found adjacent to the section treated.

The results to be obtained in either "Retread" or "Oil Mix" depend primarily upon the strength of the base over which applied. If properly built over good bases either process will give satisfactory results, and will accommodate a much larger volume of traffic than an ordinary stone or gravel road will carry. Also, the dust nuisance has been eliminated and the riding surface in most cases is almost ideal.

In Missouri we do not have as yet a very large mileage of bases suitable for construction of bituminous surface, but we are continuing our experimental work, in anticipation of the day when such bases will be available and the public will demand a better type of surfacing than is afforded by gravel and stone roads.

Acknowledgment.—The above is an abstract of a paper presented Feb. 27 at the 5th annual Southwest Road Show and School.

Simplification of Sizes of Aggregates

Reduction of Number of Aggregate Sizes Required in Different Areas Desirable

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FOR many years engineers and aggregate producers have discussed "standardization" of specifications for aggregate sizes and have even gone so far as to propose a series of so-called standard sizes which were adopted as tentative a number of years ago by the American Society for Testing Materials. It now appears that possibly our efforts in this direction have been largely misdirected because we have been endeavoring to establish definite specifications for a single series of standard sizes for materials which occur in nature in widely different sizes and gradings. From the point of view of the engineer there appears to be no reason why absolute standardization should be affected throughout the United States. The producer of gravel in the Detroit region is not interested in specifications drawn by the cities of Boston or San Francisco. He is, however, vitally interested not only in the specifications which may be drawn by the city of Detroit but also in those which may be prepared by all other users of gravel in the territory which he serves. Furthermore, the multiplicity of sizes which may be required by users within his territory is just as confusing and works just as great a hardship upon him as any similar situation in the larger national field.

The Outstanding Need.—The outstanding need in the way of simplification of sizes of aggregates is the reduction of the number of different sizes demanded of the producer in each of the major centers of production and distribution. The producer of sand and gravel, while a manufacturer in a certain sense, is not a manufacturer in the same sense as the producer of such products as paving brick. In the production of paving brick the size to be manufactured is directly under the control of the manufacturer and is not influenced by the character of the raw material. The same is true of most manufactured products. With sand and gravel, however, the producer is faced with the necessity of utilizing the material which nature has furnished to the best advantage. The sizes and gradings of the finished products which can be economically supplied are influenced to a marked degree by the size and grading of the pit run material. The producer can not supply material with a 2-in. maximum size when the largest gravel in his pit is 1 in. Neither can he economically supply an aggregate complying with a specification which calls for a preponderance of the larger sizes when to do so would mean the wasting of large quantities of the smaller sizes. Specifications for sand and gravel in any given region are of necessity dependent upon the character of the materials available in that region which of course means that specifications for materials for the same use in different sections of the country may and probably should be quite different.

Too many specifications are written in rule of thumb fashion without regard to the most economical use of the available material. Engineers are slow to recognize that the exact limiting sizes or exact range in sizes for a given product are not nearly so important as is the question of uniformity of successive shipments of the particular size and grading specified. This is particularly true where the aggregate is to be used in designed mixes of portland cement concrete as opposed to the method of designating arbitrary proportions. The engineer should be able to design a mixture of the required quality with any given aggregates regardless of the exact grading of the aggreates furnished. He should, however, have assurance that aggregates of the size and grading from which he established his design can and will be furnished on the job from start to finish. The same is true of other uses of sand and gravel.

Uniformity is far more important than adherence to some arbitrary size limit and simplification by reduction of the number of sizes required within a given territory will unquestionably facilitate compliance with requirements for uniformity. The producer, having to manufacture and stock only a few distinct grades instead of many grades differing only slightly in size, is in a much better position to make uniform and mutually satisfactory deliveries on any given project. Aggregate producers are willing and anxious to comply with the specifications and it is obvious that the task will be greatly simplified if there is only one instead of a dozen specifications to meet for a given use.

On the other hand, the engineer is responsible for the quality of construction and he must be convinced that the size which he will be required to use under a simplification program will be as satisfactory as the sizes which he has been using. Simplification should be a matter of joint effort between producer and consumer.

Adoption of Series of Nominal Size Limits Practicable.—For the above reasons it is believed that national standardization of specifications for sand and gravel is neither necessary nor desirable. However, there is good reason for the simplification by reduction of the unnecessarily large number of sizes now specified in the various production regions. It will also be helpful to adopt a series of nominal size limits covering the major uses of sand and gravel, such as has been recommended by the committee on standards of the National Sand and Gravel Association. Since these are merely nominal maximum and minimum size limits they would in no sense be considered as specifications but would be subject to further definition by the insertion of suitable intermediate size requirements, tolerances, etc., to meet local conditions.

As the first step in the simplification program, the suggested size limits could be used as a frame upon which to build the simplified specification requirements best suited to each production district. The adoption of actual specifications limits would, of course, be a matter of joint action by producer and consumer in each case and this would have to be accomplished before any real benefits from simplification would accrue to either producer or consumer. A paper presented before the meeting of the American Concrete Institute[1] describes efforts made along this line in the Detroit area and illustrates a type of joint effort which

[1] Williams, L. E., Confusion of Specifications for Aggregates. Proceedings American Concrete Institute, vol. 25, 1929, pp. 642-650.

Table I—Recommendations of Standards Committee of National Sand and Gravel Association for Commercial Sizes of Sand and Gravel

Commercial sizes: Square sieves	Commercial sizes: Round screens	Typical uses
SAND		
0 to No. 8		Sheet asphalt, bituminous concrete, plaster mortar, grout, etc.
0 to ⅜ in.	0 to $\frac{7}{16}$ in.	Concrete, etc.
GRAVEL		
No. 4 to ½ in.	¼ to ⅝ in.	Thin concrete sections, concrete building units, bituminous surface treatment, etc.
No. 4 to ¾ in.	¼ to ⅞ in.	Light reinforced concrete construction, maintenance gravel roads, etc.
No. 4 to 1 in.	¼ to 1¼ in.	General use as concrete aggregate.
No. 4 to 1½ in.	¼ to 2 in.	Concrete highway construction and general concrete work.
No. 4 to 2 in.	¼ to 2½ in.	Concrete highway construction and heavy reinforced concrete work.
No. 4 to 2½ in.	¼ to 3 in.	

should accomplish results. It is understood that similar efforts are being made in the Pittsburgh and other districts.

With regard to the recommendation made by the standards committee of the National Sand and Gravel Association for limiting sizes for standard grades of sand and gravel, it is desired to make a few comments. Two grades of sand and five grades of gravel have been recommended, as shown in Table I.

The various size limits in Table I have been given in terms of both square-mesh sieves and round-hole screens. Reference to both types is necessary, as a single standard method of measuring size of coarse aggregates has not yet been agreed on.

It is believed that the ⅜-in maximum size for sand for concrete is somewhat high and is not in proper relation to the minimum size of gravel which is given in all cases as the No. 4 screen. The ⅜-in. square-mesh sieve has a round hole equivalent of about 7/16 in. or almost ½ in., which is larger than the usual limit for concrete sand.

Another comment is in regard to the method of designating all material from the No. 4 sieve to the maximum size, say 2 in. as a single size. It is recognized that in many plants the gravel is not screened into several primary sizes while in others, particularly in many of the larger plants, this practice is followed. The other method of size designation is preferred; that is, each primary separation is considered as a primary size and combinations of them are considered as combination sizes. In other words, the primary gravel sizes would then be:

No. 4 sieve to ½ in.
½ in. to ¾ in.
¾ in. to 1 in.
1 in. to 1½ in.
1½ in. to 2 in.
2 in. to 2½ in.

Proposed Plan Will Facilitate Shipping of Aggregate in Separated Sizes.—It would not be necessary for every gravel producer to screen his product into these five separate products. A specification could still require, for example, No. 4 sieve to 1½ in. with suitable intermediate requirements, tolerances, etc. Such a specification would simply mean that the specified material includes four of the primary sizes. Whether the material is made up of the four sizes previously screened and then blended to conform to the specification or whether only two sizes have been originally made, say No. 4 sieve to ¾ in. and ¾ in. to 1½ in. is a matter of local control. The material might be produced without any separations whatever between the upper and lower limits provided it is possible to do so and still meet the specifications.

Designating the primary separations in the manner indicated above, has one obvious advantage. It makes possible, under favorable circumstances, the shipping of gravel to the job in two or more separated sizes. In such a case, the engineer specifies the number of tons of each size desired and the producer ships each size separately. It is believed that the time is not far distant when engineers will realize the advantages in the way of increased uniformity to be gained by batching the coarse aggregate in more than one size. It is practically a physical impossibility to handle a shipment of coarse aggregate in which the size ranges from No. 4 to, say, 1½-in. square mesh without segregation. It is believed that we will eventually discard the present unscientific and haphazard method of handling coarse aggregate in favor of a method which will insure that every batch of concrete will be like every other batch. Nothing will contribute more to this end than the adoption of this practice in handling aggregates.

Let us look into the matter from the producer's standpoint. What change in present manufacturing and distributing practice would be involved? In the first place, how many important gravel plants handle material running up to, say 2 in. in size, which do not make at least one intermediate separation at either ¾ in. or 1 in.? In the large producing centers the demand for most if not all of the sizes listed by the committee is sufficient to require the installation of screens for each maximum size specified. However, in many plants, instead of separating the product into a number of primary sizes, and then recombining them, gravel of any desired maximum size is obtained by screening out the oversize gravel, which is either crushed or wasted as local conditions dictate. Most of the large gravel plants have more or less complicated combinations of screens, bins, and chutes arranged and added to from time to time in an effort to manufacture graded products to meet definite specification requirements. In some plants these installations are so complicated that it is difficult for anyone but the plant superintendent to understand them. Even though these arrangements may be so designed as to blend sizes perfectly in the bin or in the car, segregation in handling will frequently undo the work. It seems desirable to adopt the rational and simple method of screening the product into the number of primary sizes dictated by the character of the material and the demand and avoid all this trouble. Such a plan will require a radical change in construction practice and it will be necessary to convince both the engineer and the producer as to its desirability.

Simplification Attainable Only Through Cooperation of Producer and Consumer.—The matter of separated sizes though related in a general way to the subject under discussion, is not the question of primary interest. The question of immediate concern is how to reduce the number of sizes of sand and gravel which commercial producers are now required to produce and stock. As has been stated, acceptance of the recommended nominal standard sizes by the industry and the user appears to be the first step. The Division of Simplified Practice of the Department of Commerce is admirably equipped to cooperate with the industry in carrying forward this part of the program. However, acceptance of these limiting sizes will not relieve the producer who is harassed with a number of specifications differing as to intermediate size requirements even though the upper and loyer limits may be the same. The specifications of the various users for any aggregate for a given purpose must be the same in any given production region before the problem is solved.

Regional committees made up of representatives of both the producers and the consumers should be formed for this purpose. In this work the producer should take the initiative. He is, as a rule, better organized than the consumer. His interests in the matter are also more obvious though perhaps not more real than those of the consumer. The regions or areas into which this phase of the simplification program would be divided would correspond obviously to the centers of greatest commercial activity; that is, the regions within shipping radius of the large centers of population. We have already noted activity of this sort under way in at least two such areas—Detroit and Pittsburgh. It can be extended to other areas where similar problems have arisen. The national association, through its representative members in these regions, is the logical organization to initiate the program.

The Bureau of Public Roads is thoroughly in sympathy with the simplification of sizes and varieties of the various manufactured products used in the construction of roads. The recommendations of the Division of Simplified Practice in the matter of grades of asphalt and varieties and sizes of paving brick have been widely followed by both the industries involved and the user and there is every reason to believe that similar success will attend the efforts which the National Sand and Gravel Association is about to initiate in the matter of simplification of sizes of sand and gravel.

Acknowledgment.—The foregoing is a paper presented Jan. 29 at the annual meeting of the National Sand and Gravel Association.

Road Construction in Saskatchewan, Canada, in 1929.—A very satisfactory program of highway construction was carried out in the Province in 1929. This program, which includes four trans-provincial gravel highways, will not be completed for about five years, and will eventually cost between $10,000,000 and $15,000,000.

Road Work in Victoria, Australia

Some Notes on the Construction and Maintenance Operations During the Past Year

THE highways of the state of Victoria, Australia, are divided into three classes: state highways, main roads, and developmental roads, and the whole are under the jurisdiction of the Country Roads Board, of which L. F. Loder is chief engineer. The board has its headquarters at Melbourne. During the fiscal year ended June 30, 1929, the expenditures by the board totaled $10,112,000, of which $3,263,000 was expended on state highways, $3,493,000 on main roads, and $2,889,000 on developmental roads. Of the above expenditures $1,955,000 was for the maintenance of the 1,509 mile system of state highways and $2,477,000 for the maintenance of the 5,562 miles of main roads. In passing it may be noted that motor registrations in the past year comprised 143,407 motor vehicles and 24,554 motorcycles.

State Highways.—Still further improvement of the state highways was effected during the year by continuing the work of reconditioning and surfacing with bituminous macadam those sections where the volume of traffic justified, and grubbing, clearing, and forming lengths in the more outlying portions of the state. The work on these highways included 77 miles of bituminous macadam, 6 miles of water-bound macadam, 45 miles of graveling and 5 miles of clearing and grading.

On sections used by comparatively light traffic, the utilization of materials obtainable in the locality at a low cost, and the subsequent surface treatment with bitumen, has produced serviceable roads at a minimum of cost, which can be maintained at a reasonable figure.

As in previous years, a policy of improving the highways progressively as the increase in the intensity of of traffic demands was pursued. By a system of traffic counts taken generally twice yearly on the highways, the board has been enabled to determine the type of construction most suitable for requirements. These counts have, in every instance, revealed that well constructed graveled roads, efficiently maintained, will generally give satisfactory service for rural traffic in this state.

For this reason the board is giving close attention to the use of gravels in districts where the census returns indicate vehicular traffic is limited to such an extent as to justify their use. When procurable, local materials have been utilized, with suitable treatment when necessary to secure the required consolidation and economical surface. With this type of road, progressive construction can be successfully applied as the density of the traffic increases, without disturbing the original surface.

The traffic requirements of areas adjacent to centers of population involved during previous years the laying of pavements in bituminous concrete or cement concrete, and the work done will fulfill all requirements for some time.

Developmental Roads

As the work of reconditioning the highways proceeds, the board is installing patrol gangs to ensure the adequate and efficient maintenance of the completed work. Individual patrolmen have been replaced by truck patrols operating on length of approximately 40 miles on the sections completed with a bituminous surfacing, and roadmasters have been appointed to control the maintenance on sections where short patrol lengths are necessary.

Main Roads.—With the exception of 12.29 miles, which were constructed under the Country Roads Board's direct supervision, new construction works on main roads involving the expenditure of loan moneys was carried out by municipal councils. The total length of the roads constructed under municipal supervision was 138 miles. Twelve bridges with approaches are included in the work supervised by the board, the remainder comprising mainly bituminous surface work for which the board's plant was available. As with construction, the work of maintenance was in the main carried out by the municipal councils concerned.

Developmental Roads.—Developmental road work was carried out chiefly by councils of the shires within whose districts the works are situated. Almost every shire outside the boundaries of the metropolitan area participated in the expenditure, but the major part of the work consisted of constructing roads or erecting bridges in the more remote and undeveloped parts of the state in order to provide access to a state highway, main road, railway station, or market town.

The extent of the works directly supervised by the board was 184.11 miles of roads mainly constructed under contracts, eleven separate works having been carried out by day labor. Fifteen bridges erected by contract are included in the works supervised directly by the board.

The type of road constructed was mainly broken stone or gravel, which can later be provided with a bitumen surface when the volume of traffic justifies. It has been found, however, that in many cases the completion of developmental roads has had the effect of attracting traffic to such an extent that their upkeep and maintenance—for which the shire council is wholly responsible—has become a serious problem. This is particularly so where newly constructed developmental roads lead to main roads or state highways and draw traffic not of local origin, in addition to carrying the local farmers' vehicles.

Bituminous Macadam.—The specifications of the Country Roads Board for bituminous macadam, the result of several years' experience under conditions prevailing in the state of Victoria, provide for sealing the work immediately after construction. By this method it is considered that covering with gravel or screenings in the summer, which is one of the chief items of maintenance on a road sealed with bitumen or tar, will be avoided, as the incorporation of the mineral matter in the seal coat will be continued during the whole of the period of back-rolling necessary for the complete consolidation of the bituminous macadam. The section of the specifications regarding sealing follow:

Preparation of Road.—Before the seal coat is applied, any excess screenings shall be swept off the road until the condition of the surface is such that the top surfaces of the stones are exposed with the interstices between them completely filled with screenings.

Covering Material.—The covering material shall consist of fine screenings as previously specified.

Application of Bitumen.—The bitumen shall be applied by an approved machine or by hand within 24 hours of the completion of the bituminous macadam surface.

The distribution of the bitumen shall be uniform at the rate of 0.30 gal. per square yard of surface. The temperature of the bitumen at the time of application shall not be less than 300° F. Application shall not be carried out unless the road is thoroughly dry or if there is any immediate prospect of rain. The superintending officer's decision in this respect shall be final. Hand pouring shall be carried out

Pykes Creek Bridge Showing Welded Steel Trusses Partly Erected

diagonally at such an angle to the road that the contents of the pot are entirely used in one pour. The direction of the pouring shall be such as to make the greatest angle with the direction of pouring used for the penetration application.

After application, the bitumen shall be immediately covered uniformly with screenings as specified at the rate of approximately 1 cu. yd. of screenings to 80 sq yd. of road surface, and rolled with a power roller; any places where asphaltic cement shows through shall be covered with more screenings and re-rolled. The road may then be re-opened to traffic, provided that permission is given to do so by the board's superintending officer.

Premixed Seal Coat.—On one section of road that had recently been widened and resurfaced with bituminous macadam, instead of sealing with a sprayed coat of bitumen in the usual way, it was decided to lay upon the unsealed bituminous macadam a seal coat consisting of a thin coating of sheet asphalt. The sand, filler and bitumen were heated and premixed in the required proportions at a central mixing plant, spread upon the bituminous macadam surfacing at the rate of 50 lb. per square yard, and consolidated by rolling.

The quantity of asphalt applied, which is equivalent to approximately ½ in. of consolidated asphalt, if the material were laid upon a perfectly true surface, gives a minimum cover of approximately ⅜ in. over the high points of the bituminous surfacing, the remaining material filling the voids in the surface and being used to take out any irregularities.

Filler was added at the rate of 5 per cent of the total dry mix, and the quantity of bitumen, which was of 40-50 penetration, varied between 9 and 10.

Light Welded Trusses Used for Form Supports.—One of the largest bridges constructed during the past year was a 246 ft. long, 22 ft. wide reinforced concrete structure. The superstructure was designed as a continuous bridge, and the foundations were carried down to the sandstone rock which occurs at a shallow depth. By making the span lengths 40¼ ft., 54½ ft., 56½ ft., 54½ ft., and 40¼ ft., it was found that only two piers were in the water, and also that the bending moments in the center spans were equal to those in the end spans, one end of each of which was freely supported to provide for expansion.

The substructure of the bridge was done by day labor because of the uncertainty of cost due to variations in the water level. For the two piers in the water, a light timber platform was erected, and after the bases were excavated to the solid rock concrete was placed through water by a bottom dump bucket using as forms circular corrugated iron cylinders lined with plain iron. Use was made of pneumatic hammers working under water to prepare the base of the rock foundations.

Because of the height above water and the cost of providing adequate staging for the forming of the superstructure, use was made of light welded trusses. These trusses were designed to act as partial reinforcement when embedded in the concrete beams, and also to support the forms and concrete during the casting of the superstructure.

Community Dividends

That in general a community gains rather than loses by having public lands which are exempted from taxation is pointed out in the Public Finance Section of a Report on Government, which is one of the 1929 publications of the Regional Plan of New York and Its Environs.

"The fear that reservation of land for public use will result in loss of revenues because such land is exempted from taxation," says the report, "is largely fallacious. When a large area of land is set apart for a park or water-supply reservation, this does not mean that the public loses revenue from potential building land.

The reservation being made, the effect may actually be to increase the areas used for buildings and also to increase the value of the buildings in a municipality, when there is adequate space for development, by reason of the greater attractiveness created by the public reservation. In any case, the buildings that might go on the land reserved simply go elsewhere in the same area.

The public get their revenues from building uses just as if no reservation existed, and obtain the social advantages of the public open space in addition. Public authorities that resist proposals to reserve areas of open land in the proper places, on the assumption that, as such land is untaxable, therefore revenue will be lost, are defeating their own purpose.

Bituminous Seal Coat on Granitic Sand

Bituminous Retread in Missouri

An Interesting Description of the Procedure Followed by the State Highway Department, Together with Cost Data on Recent Work

By C. P. OWENS

Engineer of Maintenance, Missouri State Highway Department

THE retread procedure followed in Missouri has been copied largely from the method originating in Indiana, with certain modification to meet our requirements and as improvements to obtain better results.

Our first retread work was built in 1927 near Springfield, where clay bound macadam roads had been constructed from the crushed field stone which abounded along the fence rows in that locality. While these macadam roads were solid and showed no signs of base failure, they were rough and very difficult to maintain, due to the large percentage of clay binder, the oversize material, and the rapidly increasing traffic which was beginning to find its way into the Ozark region, especially during the tourist season. The road selected had been requiring large sums for maintenance and had never been in a satisfactory condition regardless of the expenditures.

"Retread," may be constructed in any thickness from ¾ in. to 3 in. However, on the section selected as a test section it was decided to build a 2 in. surface throughout, as it was judged impossible to obtain the desired riding quality and stability in a thickness of less depth. The coarse aggregate was produced at two entirely different sources and was of two distinct types; namely, crushed limestone and crushed flint. It was graded in size from 2½ in. to ¾ in. and from 1½ in. to ¾ in. The bituminous materials used on the various test sections were light and heavy grades of tar and a medium grade of cut-back asphalt. Short sections of the road were laid out and a systematic effort made to use each grade of bituminous material with each grade of stone for purposes of comparison and future reference. Hand labor was replaced with equipment at every possible opportunity.

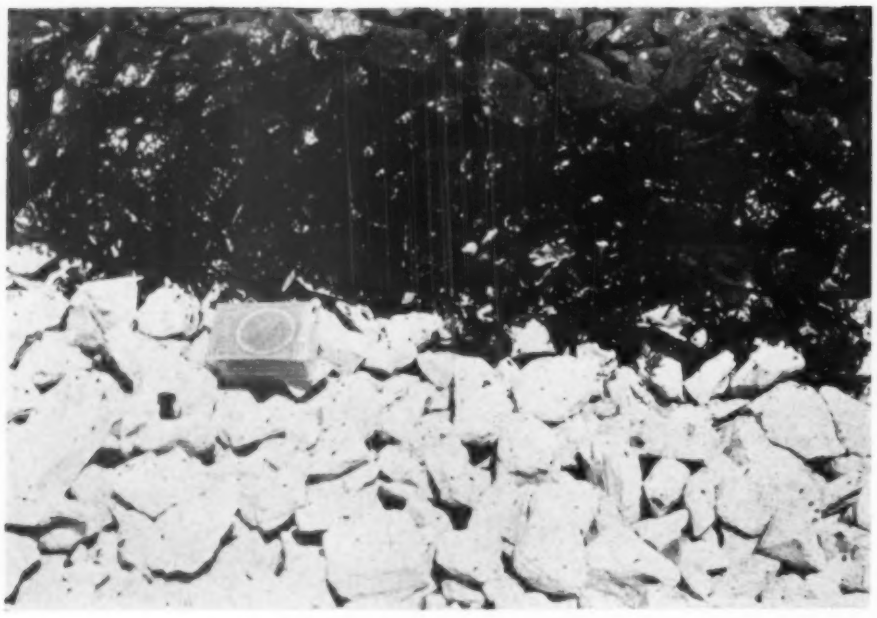
Many obstacles were encountered in this first experiment. It was found that some grades of bituminous material used were entirely too light and that the setting up action was extremely slow and delayed progress. The crushed flint used as a coarse aggregate seemed to retard the setting of the bituminous material, and was thus a source of some worry. Some of the aggregate was poorly graded and too fine. Numerous other obstacles arose to worry those in charge of the work, but all were ironed out and solutions found. The section was completed before cold weather.

Varying opinions existed at that time concerning the life of this pavement. Due to the leanness of the mix and the open nature of the surface, it was fully predicted by many that very little of the surface would go through the winter intact. However, it was common opinion that the riding surface was exceptionally good, considering the condition of the base over which it had been built. For these reasons observations were made of the section at frequent intervals during the winter.

Road After Being Swept and Primed Before Application of Rock

When spring came, the section was found to have come through the winter in very good condition. Some raveling had occurred but repairs had been made and the section generally looked promising. In fact the results were so good that we decided to purchase new equipment, and the following equipment was obtained: one 650-gal. pressure distributor, mounted on dual pneumatic tires; one 5-ton 3-wheeled roller; one 10-ton 3-wheeled roller, both equipped with sprinkling device; one 20-hp. crawler tractor; one multiple blade maintainer, and

Spreading the Rock



Surface After First Application of Bitumen

four 1½-ton trucks, equipped with hydraulic hoists and dump bodies.

The Work in 1928 and 1929.—The program for 1928 included short sections of work at various points in the state, where bases existed which were judged to be of sufficient worth to warrant a retread surface. It was planned to scatter the work widely, so as to give the division engineers in each part of the state an opportunity to study the method of construction and to observe the results to be obtained under various climatic and soil conditions.

We continued our work during 1929. We felt that we were gaining considerable experience of much value. Before starting our 1929 program we revised our specifications to include only large stone passing 2½-in. screen and retained on 1-in. screen, as we felt the larger size aggregate gave better results than the smaller size aggregate, ranging from 1½ in. to ¾ in. Also, we asked for heavier tars with viscosity ranging from 40 to 50 instead of 25 to 40, and we began using heavier grades of cut-backs. Also, we decided to prime the base before applying retread, using a light tar of viscosity ranging from 11 to 18.

Preparation of Base.—The procedure followed during 1929 is outlined as follows: The gravel or stone base is carefully bladed to eliminate irregularities and to remove surplus loose material to windrows on both shoulders. Ditches are cleaned and the dirt deposited on the shoulder, along with the surplus gravel windrow to form a shoulder berm to hold the loose aggregate to be placed later on the roadway.

The base thus prepared is then primed with an 11 to 18 viscosity tar at the rate of ¼ gal. per square yard. The tar is allowed to penetrate thoroughly and no covering is applied. This tar helps to water-proof and bind the base, and also serves to eliminate dust and loose material on the surface.

The Coarse Aggregate.—The coarse aggregate, which we prefer to be of good quality limestone passing 2½-in. mesh and retained on 1-in. mesh, is then hauled and spread on the road from dump trucks. The coarse aggregate is spread uniformly at the rate of 140 lb. per square yard. Trucks should be equipped with flat bottom dump beds, hoists and adjustable tail gates. Truck drivers soon learn to drive at the required speed to obtain the desired uniform distribution. Each loaded truck of known quantity must cover a specified distance while dumping, just the same as is done in spreading bituminous material with a distributor. We found it good practice to underrun the desired quantity slightly and to check up each ½ mile on total quantities used, using the accumulated surplus to touch up thin places by shoveling directly from truck. This procedure insures highly accurate and uniform distribution.

After the aggregate is spread, a blade machine or a maintainer is used to eliminate irregularities and to true up the cross-section. This blading should be done very lightly to avoid displacement of aggregate or disturbing the uniform distribution. This process also shakes the smaller stone to the bottom to serve later as bottom key stone, leaving the larger stone only exposed on the surface. The final appearance is that of a stone covering consisting mainly of large stone 2½ in. in diameter.

First Applications of Bitumen.—The next step is to apply bitumen at the rate of ½ gal. per square yard, using either cut-back asphalt or refined tar. This amount is sufficient to penetrate through the entire depth of the stone and to adhere to the base slightly. However, this application is not enough to thoroughly coat all surfaces of the stone.

Immediately following the first application of bitumen, the stone is thoroughly bladed with the multiple blade maintainer. A straight blade grader may also be used to mix and turn the stone. Care should be used to avoid too much blading or lateral movement of stone, which will result in the segregation of aggregates. The only blading necessary is to partially mix and turn the stone and to level the surface to its true cross-section and profile eliminating high spots and depressions.

Following this the entire surface is rolled once over with a 3-wheel roller so as to smooth the surface and key

Surface After First Application of Chips and Second Application of Bitumen and Rolling

the aggregate. The surface is then allowed to lay in that condition until the bitumen has hardened sufficiently to support the trucks. This period varies from a few hours to possibly several days, depending on the aggregate used, the grade and kind of bituminous material, and the atmospheric conditions. We use the heavy grade of cut-back asphalt. We use tars of 38 to 40 viscosity, but these are slow curing and we prefer heavier grades of tar.

Application of Chips.—The next process is to spread either limestone or flint chips at the rate of 12 to 15 lb. per square yard. These chips are spread directly from the adjustable tail gates of trucks driven at a speed to obtain the desired results. A truck load of determined quantity is required to spread over the required distance, and until truck drivers become proficient it is necessary to stake these distances so the drivers can correct errors.

Second Application of Bitumen.—The second application of bitumen is then made at the rate of 0.3 gal. per square yard, after which the surface is rolled thoroughly. Some times the second application of bitumen softens the first so that immediate rolling is not practical. The rolling must be done at the proper time for best results, and this is after the time when the mushy condition begins to disappear and the bitumen is tacky, but before final set of bitumen occurs. The rolling should be started on one edge with the rear wheel overlapping, and rolling the shoulder. Rolling should continue towards the center so as to thoroughly smooth and key the aggregate. Water is used on the roller wheels to prevent picking up and sticking of bitumen. Proper rolling at the proper time, in a thorough manner is highly important.

Surface After Second Application of Chips

Second Application of Stone.—The next step is to spread the second application of stone or flint chips at the rate of 18 to 20 lb. per square yard. The quantity of chips to be used can be determined by trial and appearance, being careful to avoid an excess. Only enough chips should be used to fill all voids and to smooth out irregularities in the surface. The size of stone used, the gradation of stone or proportion of fines compared to coarse, and the extent of crushing of stone under roller wheels determine the amount of chips to use.

One mighty good rule to follow throughout retread construction is the rule you follow in salting your soup. It is always easy to put more in if needed but hard to take out any excess. This rule applies equally well to bitumen as to chips and an excess of either is just as bad as an excess of salt in soup. This rule is worth remembering if you want to have success with retread.

The chips may be distributed uniformly by means of a broom drag consisting of push brooms nailed to a 2 by 4 and attached to the bumper of a car or truck. Even a drag of an old carpet or canvas will accomplish the results desired.

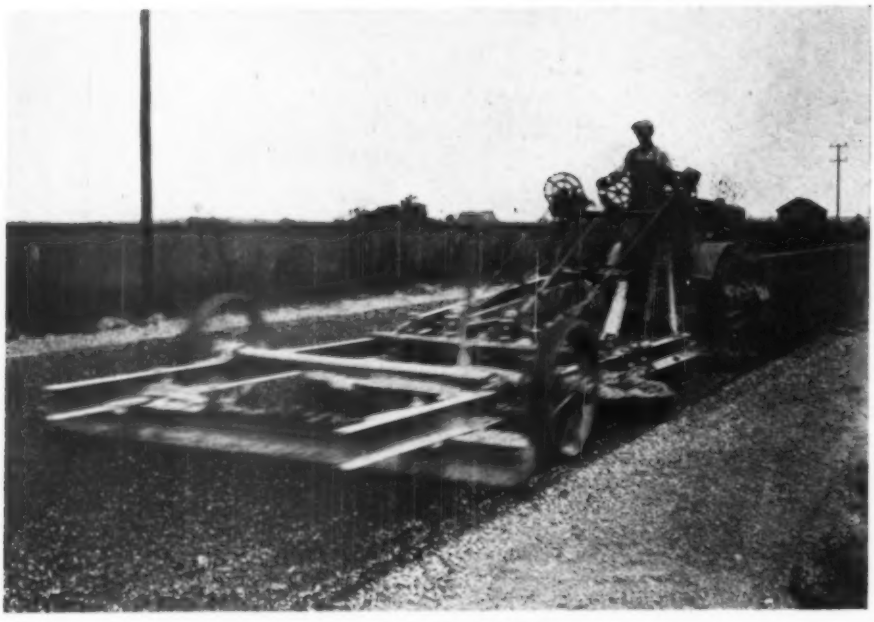
Third Application of Bitumen.—After the chips are uniformly spread, the third application of bitumen is made at the rate of 0.3 gal. per square yard. Immediately following the third application, a multiple blade maintainer, or a heavy long base multiple blade drag, is used to thoroughly mix the chips and bitumen and to level and smooth the surface. A heavy long base drag or maintainer is essential to obtain a true smooth riding surface so essential in this modern age of high speed transportation.

This final heavy dragging process, or honing process, forces the coated chips into the voids and depressions and cuts and shaves off all bumps. Sometimes stones are actually jerked from the surface or sheared off, but such places are easily patched by hand if not corrected by the dragging process itself.

By using care in the first dragging, leveling and rolling process, the need for filling depressions and planing of high spots is reduced to a minimum in the final process. The final result is better if the need of using coated chips to fill depressions can be eliminated entirely.

After the chips are thoroughly coated and spread, the entire surface should be given its final and thorough rolling, after which the road may be opened to traffic. For the first few days it is well to watch the results

Distribution in Operation on Second or Third Application of Bitumen



Turning Chips After Third Application of Bitumen

of traffic. Usually no further attention is necessary except possibly there may be a little surface raveling of the chips. There is no harm in this if it occurs; in reality it indicates a healthy condition.

Two Important Items.—There are two important items that must be watched and guarded against in building retread. The first is to avoid using an excess amount of bitumen. You will note that we have used 140 lb. of stone and approximately 35 lb. of chips, or a total of 175 lb. of aggregate, but only 1.1 gal. or approximately 8 lb. of bitumen per square yard. This percentage of bitumen is enough to coat all particles and to bind the aggregate together. To use more would be a waste of money and will usually result in subsequent shoving under traffic with the attendant rough-corrugated surface. This condition is hard to correct, but is easily avoided, if you can overcome your natural tendency to build a fat pavement.

The second important item to remember is the basic nature of the bituminous material you are using. These bituminous materials are made from fairly heavy bases softened or liquefied by the addition of a valatile solvent. These solvents must be allowed to come off if you expect the desired results. The use of an excess amount of bitumen tends to seal the surface, or the application of a seal coat will prevent full evaporation of the liquefier. Also, the too rapid construction of the successive applications of chips and bitumen tend to seal the surface before the curing process has been completed. Therefore, sufficient time must be allowed between the successive steps to allow the solvents to evaporate. Furthermore, the aggregate used in retread should be large enough not only to give stability but to aid in building the open type so essential when cut-backs are used. Keeping the solvents sealed in would be quite comparable to keeping the heat sealed in on a penetration macadam job.

On some of our small jobs built in 1928, we rushed the work and one step closely followed the preceding, with the result that a few of these jobs are tightly sealed and the surface has waved and shoved under the action of traffic. Upon digging up samples in 1929, we found the bitumen in the base of the sections built in 1928 still soft and sticky and still bearing the odor of the solvents used.

Sealing the Surface.—After the retread has been down several months, it may be desirable to seal the surface with a light grade of asphalt of 200 to 250 penetration. Usually ¼ gal. of asphalt and 25 pounds of sharp sand per square yard is sufficient. I believe the best practice is to apply the seal coat the following year after the construction. The seal coat should be made in hot weather and the sand should be broomed in over the surface at frequent intervals, so as to force as much of it as possible into the bituminous seal.

From our experience we find no particular harm results in permitting retread to go through the winter without a seal. Some little surface raveling may occur. During the winter and early spring base weakness may develop that were not apparent when the road was maintained as a gravel or stone road. If these places are few they may be patched readily by hand. If the failure should be on a large or general scale, due possibly to exceptional or unusual winter weather conditions, the job of repairs and restoration is not serious. It may be necessary to add some stone, reshape, add a small amount of bitumen and the surface is restored to its original or possibly better condition, by the same process followed in the original construction.

Cost Data.—The following cost data is typical of the work performed to date. This cost data does not include the cost of the seal coat, provide anything for so called overhead, profit, or interest charges, but covers field supervision, equipment rental and depreciation, and the cost of labor, tools and materials.

	Per sq. yd.
Preparation of Base	$0.012
Priming	.035
Coarse Aggregate (Plant Price $1.35 per ton)	.193
Bitumen applied	.140
Fine Aggregate	.059
Rolling	.011
Supervision	.016
Barricades, detours, and misc.	.021
Total cost per square yard	$0.487

Finished Road Except for Application of Hot Seal Coat to Be Applied in Fall or the Following Season

Thus the cost per mile for retread 18-ft. wide 2-in. thick is approximately $5000. The hot seal usually costs about $750 per mile. The annual surface maintenance on the retread built in 1927 was $45.00 for the year of 1928.

On one section of the same type road constructed in 1928, the original cost of construction was $5000 a mile. In 1929 a hot seal was applied over this section at a cost of $800 a mile. This annual surface maintenance on this section cost approximately $140 a mile.

Our experience with retread during 1927, 1928 and 1929 leads us to believe that we will see improvements in materials, aggregates and methods from time to time, but that on the whole the method is well through its purely experimental stage. We feel that it is a safe and sound method of building a cheap wearing course on bases no longer suitable for the traffic demands. It is well to keep in mind that it is not an alternate or a substitute for high type pavements but occupies an intermediate position in which there is a large field.

Acknowledgment.—The above is an abstract of a paper presented Feb. 27 at the 5th annual Southwest Roads Show and School.

U. S. Census to Collect Statistics on Construction

For the first time in the history of the country, construction statistics will be collected by the Bureau of the Census when it takes the 1930 census of the nation.

The statistics on construction will include the data obtained by the enumerators working on the special census of distribution. Figures on all construction work in process and contracted for will be obtained, sorted and compiled for the use of Federal agencies and other interested persons and organizations.

During the past few months the national staff and several members of the Associated General Contractors of America have co-operated with representatives of the Bureau of the Census in working out details, so that the collection of statistics will include the most useful data. A suitable form of return has been worked out, and the names of some 14,000 contracting organizations furnished to the Census Bureau.

It is believed that information developed by the census will enable the Association to speak with certainty in its dealings with the Government and with other industries. Data which will be useful in determining the state of the industry which will be useful in stimulating a flow of money into the construction field will also be collected.

Traffic Bound Macadam in Kentucky

The following is abstracted from an article by W. F. Johnson, Assistant District Engineer of Construction, Kentucky Highway Department, in the March issue of Kentucky Highways:

In constructing a traffic bound macadam road a trench for the metal is cut approximately 5 in. deep with a large tractor and grader, the material being thrown to each side to build the shoulders. Beginning at the end of the project nearest the quarry or shipping point, crushed limestone is then spread 1½ in. deep. As soon as this first course is applied over the entire project a second course of the same thickness is put on, making a total thickness of 3 in. An additional 1½ in. of stone is placed in stock piles along the side of the road to be used by the maintenance forces in patching weak places that develop and to keep a floater course on the road. The road is graded about three times a week with a one man power grader which keeps all holes filled up and makes a smooth riding surface.

In District No. Six, which is composed of seventeen counties in the southeastern portion of the state, several traffic bound macadam roads have been constructed during the past few years. At the present time there are 142.14 miles of traffic bound macadam roads under state maintenance and 26 miles still under construction.

In order to show the cost of construction and maintenance of these roads, the road in Lincoln and Rockcastle Counties between Stanford and Mt. Vernon will be taken as an example. This road is 22.7 miles long (not including the towns of Crab Orchard and Broadhead) and carries more traffic than any other traffic bound road in the district.

Construction of the section in Loncoln County was started June, 1928, and finished October, 1928, at a cost for the entire project of $55,655.88. The surfacing of the section in Rockcastle County was started in October, 1928. Had this contract called for any kind of surfacing other than traffic bound macadam it would have been useless to start work at this time of the year, for only a small portion of the project could have been finished before bad weather. As this was the only gap in the entire highway that had not been surfaced, every effort was put forth to complete this project. In January, 1929, both courses had been placed and traffic had never stopped. The cost of constructing this project was $42,-372.39. The total cost of construction for the 22.7 miles was $98,028.27, or a cost of $4,318.42 per mile.

As soon as these projects were built they were taken over for maintenance. The maintenance forces using the stone that was placed in the stock piles to strengthen weak places and rebuild the places that had broken through. The maintenance cost up to April, 1929, was $2,861.82.

In the summer of 1929 an additional 1 in. of stone was placed on the road and 1 in. of stone was again placed in the stock piles. The cost of maintenance for this year to Feb. 1, 1930, was $17,618.10, which includes the 2 in. of replacement stone.

Up to the present time the cost of construction and maintenance of this road is $5,220.63 per mile, which includes the cost of the stone in the stock pile that has not yet been used. By summer this cost will probably be $5,500 per mile. By that time the total thickness of the material should be about 5 or 6 in. It is then the intention of the state highway department to place a 2½-in. retread on this road which will cost approximately $4,000 per mile.

Gas Tax May Amount to $550,000,000 in 1930

The nation's gasoline tax bill for 1930 will total $550,000,000, an increase of approximately $100,000,000 over the 1929 bills, according to preliminary estimates of the American Petroleum Institute.

Early last year the Institute estimated the 1929 total at $450,000,000. Reports as of February 15, 1930, placed actual collections at $449,731,000.

The increase in the 1930 collections is based almost entirely on an expected gain in gasoline consumption.

The total takes into consideration the increased tax rate in Oregon, which moved into the 4-ct. bracket on Jan. 1.

It does not include actual or expected rate increases in other states, however, nor the recent increase in Idaho, which raised the tax to 5 ct. from 4 ct. per gallon.

Legislation seeking higher rates is pending in Mississippi, New York, New Jersey and Texas and there is agitation for increases in Massachusetts, North Dakota, Kansas, Louisiana and others.

Only Missouri, where the rate legally is fixed at 2 ct. for a decade, and California, whose state officials from the government down publicly have declared the revenues sufficient for present and contemplated highway programs, have displayed no tendency to seek higher taxes.

Institute records show that when the 1930 tax bill of $550,000,000 has been collected, motorists of the United States will have paid a total of $1,-744,400,000 in the past five years. This is more than six times greater than the total for the preceding five years, or $279,400,000.

Structures for Eliminating Grade Crossings

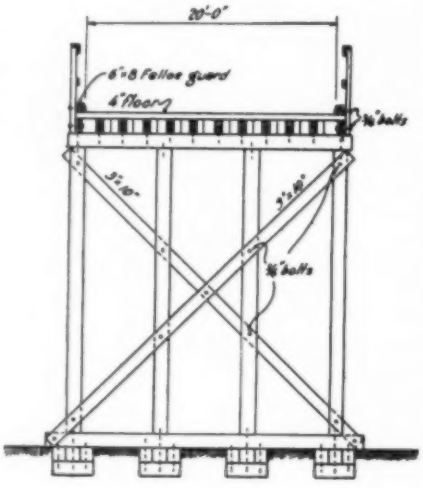
Timber Trestle—Timber Trestle with Single Steel Stringer Span—Rigid Steel Frames with Timber Floors and Concrete Abutments—Rigid Concrete Frames

INFORMATION of particular interest to officials of counties with limited engineering departments was given by the A. R. B. A. committee on grade crossings in a report submitted at the recent convention of the association. The committee consisted of the following:

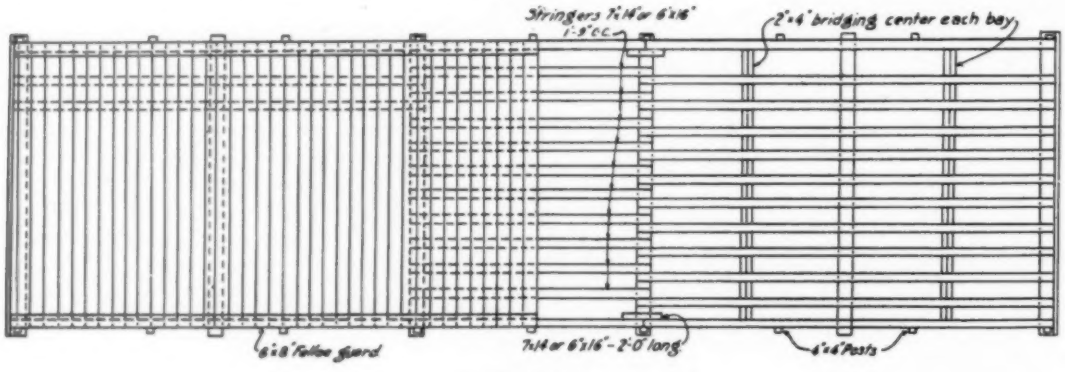
Chairman—Morris Goodkind, bridge engineer, New Jersey State Highway Commission, Trenton, N. J.; William L. Craven, bridge engineer, North Carolina State Highway Commission, Raleigh, N. C.; C. B. McCullough, bridge engineer, Oregon State Highway Commission, Salem, O.; S. B. Slack, bridge engineer, Georgia State Highway Board, East Point, Ga.

The report follows in full:

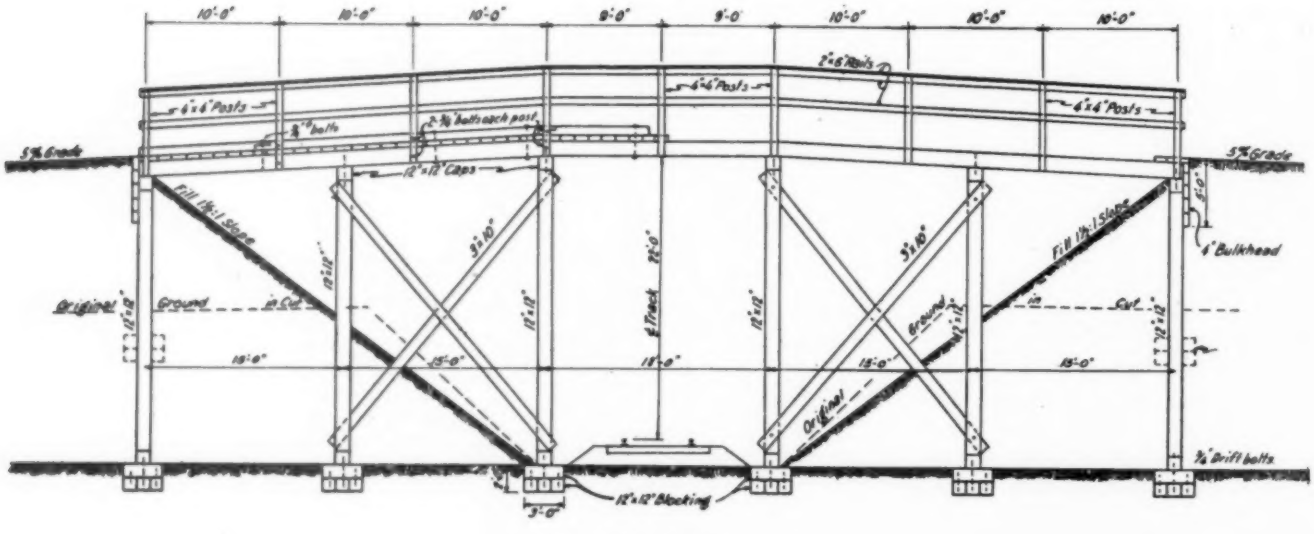
There is one grade crossing in the United States, for approximately each of the 250,000 miles of railroad. Although accidents on other parts of the highway systems of the country are much more numerous than at grade crossings, the fatalities are less. According to Mr. E. W. James of the Bureau of Public Roads, writing in a "Report on a Grade Crossing Program," presented to the American Road Builders' Association at Cleveland, O., on Jan. 16, 1929. New York State reported, for 1927, only 29 fatalities resulting from accidents at points on the highways other than at grade crossings, while the Interstate Commerce Commission reported 151 fatal accidents at grade crossings in that state. On the basis of these figures, grade crossing accidents represent 28 per cent of the total accidents which occurred in that year, while the fatalities resulting from accidents at grade crossings constituted 84 per cent of the



CROSS SECTION



PLAN



ELEVATION

Fig. 1—Timber Structure Over Single Track

Quantities

Dry excavation	43 cu. yd.
Creosoted timber	32.640 M. B. M.
Hardware	1,000 lb.

All timber treated with at least 16 lb. of creosote oil per cubic foot.

Quantities to be deducted from the above quantities for each foot decrease in height of two end bents 0.362 M. B. M.

Design Loading

2-15 ton trucks with .8 of weight on rear axles. Impact 30%.

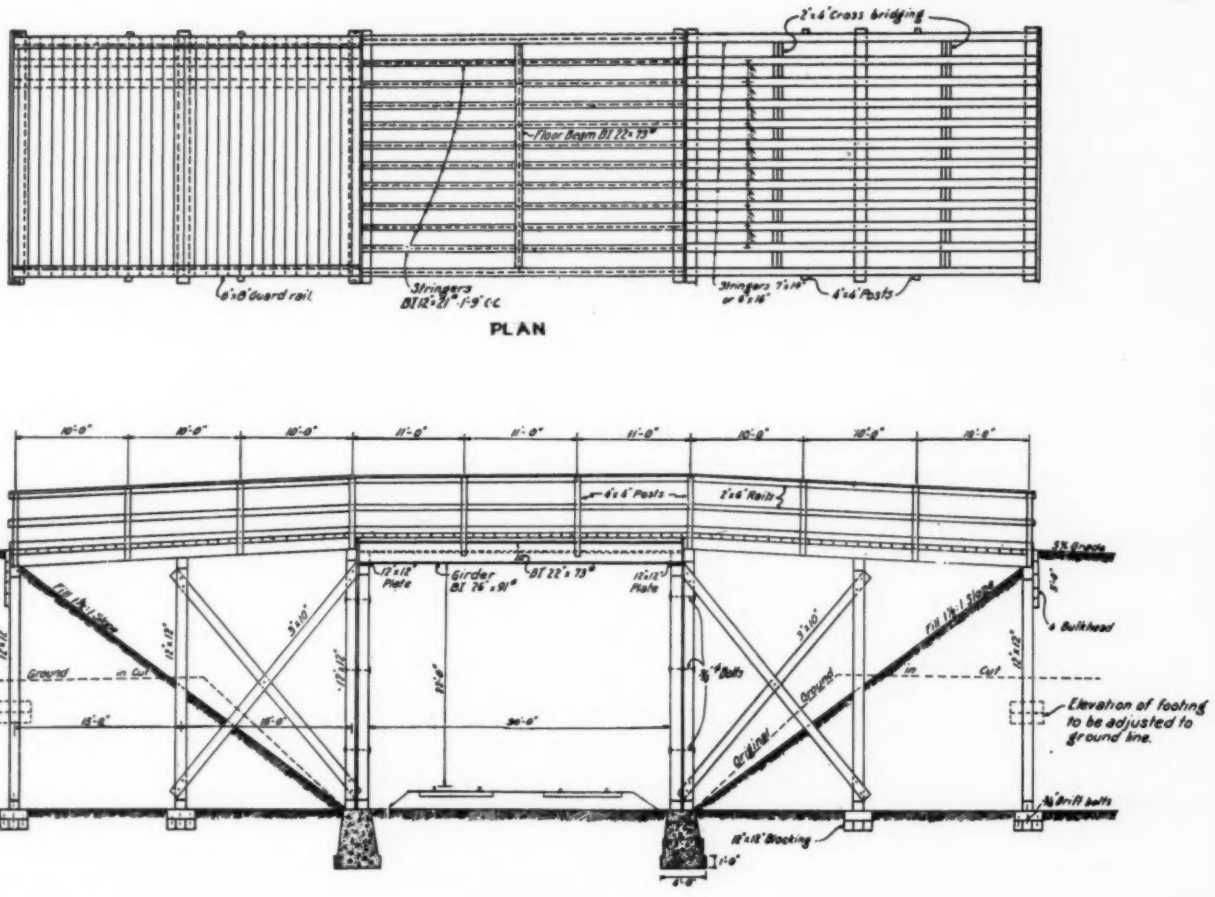


Fig. 2—Timber Structure With Steel Span Over Double Track

Quantities

Dry excavation	92 cu. yd.
Creosoted timber	34.629 M. B. M.
Hardware	1,000 lb.
Concrete	27.3 cu. yd.
Structural steel	14,220 lb.

All timber treated with at least 16 lb. of creosote oil per cubic foot.

Quantities to be deducted from the above quantities for each foot decrease in height of two end bents 0.342 M. B. M.

Design Loading

2-15 ton trucks with .8 of weight on rear axles. Impact 30%.

Note.—Maximum foundation pressure 1.7 tons per square foot.

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total number of fatalities on highways.

The risk of life at grade crossings is, therefore, about three and one-half times as great as on other parts of the highway systems. Mr. James, however, believes that such comparisons should not be pushed too far because of the possible incompleteness of the record. Nevertheless, such statements can be accepted as indications that grade crossings are much more dangerous for motorists than other parts of our highway systems. Mr. James states that we are apparently justified in putting grade crossings first in our list of details of highway design to receive attention.

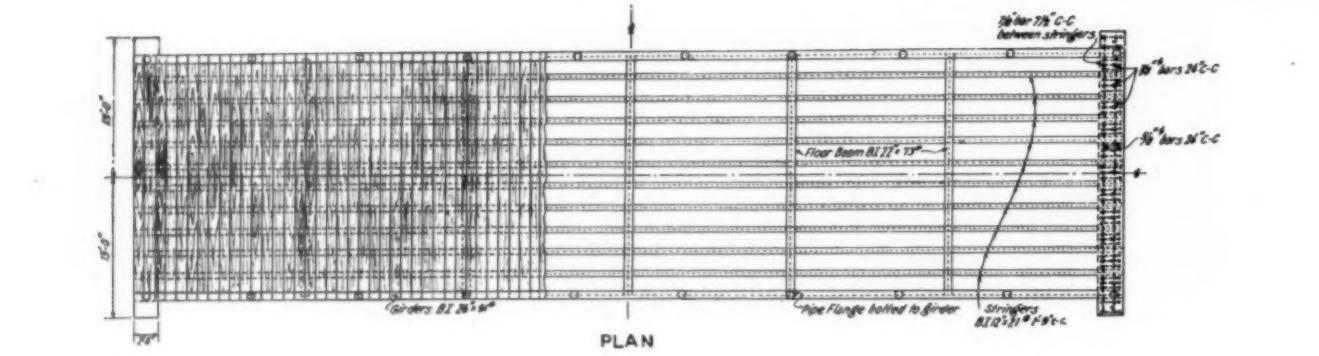
Elimination of All Grade Crossings Impossible.—The great number of these crossings makes prohibitive the cost of completely eliminating them in the near future. Consequently it is necessary that advantage be taken of every economy in design and construction of the structures which are necessary, in order to permit the maximum number of grade crossing eliminations with the funds available for this purpose.

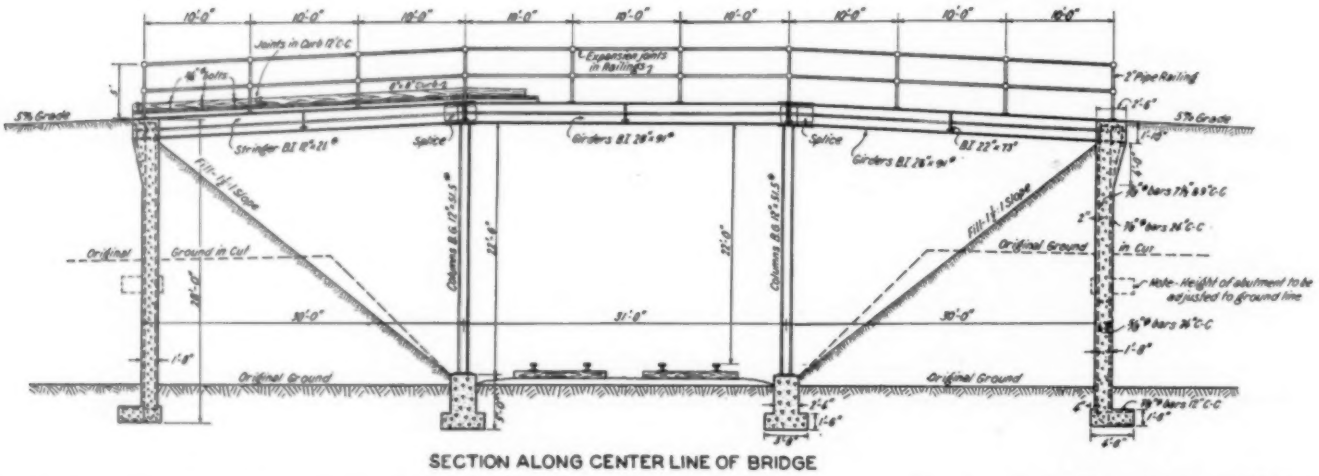
It is the purpose of this report to give officials of counties with limited engineering departments, information which may be of value to them in their grade crossing elimination work.

Overhead Crossings More Economical.—Crossings of highways and railroads at grade are usually eliminated in one of two ways. The highway may be carried over the railroad on an overhead crossing or it may be passed under the railroad by an underpass. The choice of type of crossing depends upon topographic conditions and other restrictions encountered at the proposed location. Unless the conditions are such as to make an underpass necessary, it is generally more economical to use an overhead crossing, since the underpass must be designed for heavy railroad loads and the construction is more expensive because temporary structures must be provided to carry the traffic while the permanent structure is being built. This report will deal with overhead crossings.

An overhead crossing consists of two parts; the main structure over the railroad tracks and an approach at each end of the structure. The most economical crossing is, of course, that in which the combined cost of the main structure and the approaches is a minimum. As the depth of railroad cut over which the crossing is made increases, the amount of approach fill decreases until the depth of cut equals the clearance required between the tracks and the lowest members of the overhead structure. Under this last condition the approach grading is reduced to a minimum.

In a rolling or rough country it is often possible to relocate the highway on each side of the tracks so as to cross at a railroad cut and thereby reduce the approach fills and the height of supports at the end of the structure. The extent of relocation which is jus-





tified to accomplish this purpose depends upon the relation between the cost of the relocated line and the saving in approach fill.

In very flat country, where railroad cuts are light, it is generally advisable to build the structure near the grade crossing and construct approaches consisting wholly of embankments or consisting partly of embankments and partly of trestles depending upon the relative economy of the two types of approach for the particular case under consideration. It should be kept in mind that, in flat country, the material for the approach embankments must be borrowed and additional land acquired for the purpose.

Each Grade Crossing a Special Case.—It is therefore evident that each grade crossing must be studied as a special case in order to decide upon the most satisfactory location. However, the principal features of the main structure over the tracks may be standardized to a certain extent and it is the purpose of this report to provide standard designs which, with some modification for each particular case, may be used at most locations.

The main structure may be constructed of any of the common structural materials; concrete, steel, wood or combinations of these materials. The usual practice in bridge design in this country is to use simply supported super-structures delivering a vertical reaction to the substructure.

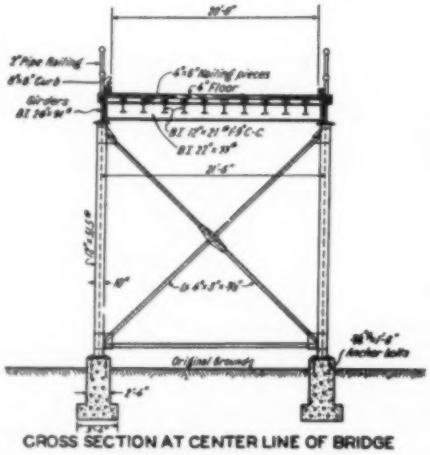


Fig. 3—Steel Structure Over Single Track

Quantities

Dry excavation	60 cu. yd.
Concrete	64.5 cu. yd.
Reinforced steel	9,688 lb.
Structural steel	48,753 lb.
Timber	10.09 M. B. M.
Pipe railing	159 lin. ft.

Quantities to be deducted from the above quantities for each foot decrease in abutment height.

Concrete 1.6 cu. yd.; reinforced steel 213 lb.

Design Loading

2-15 ton trucks with .8 of weight on rear axles. Impact 30%.

Note.—Maximum pressure 1.5 tons per square foot.

This has been done because of the ease with which the stresses may be computed. In continuous structures or rigid frames, the design is more difficult but a considerable saving in cost is possible where the parts of the structure are rigidly connected. Methods of analysis in which models are used have become widely employed and greatly reduce the work of design. Models of the structures were made from celluloid and by using the Beggs Reformeter Gauges, influence lines were obtained and stresses then computed.

Types of Structures.—The following types of structures are shown in Figs. 1 to 7:

Timber trestle over single track.

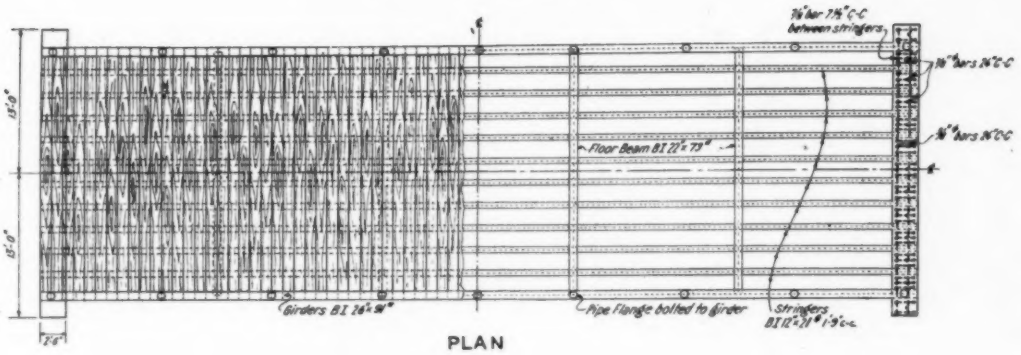
Timber trestle with single steel stringer span over double track.

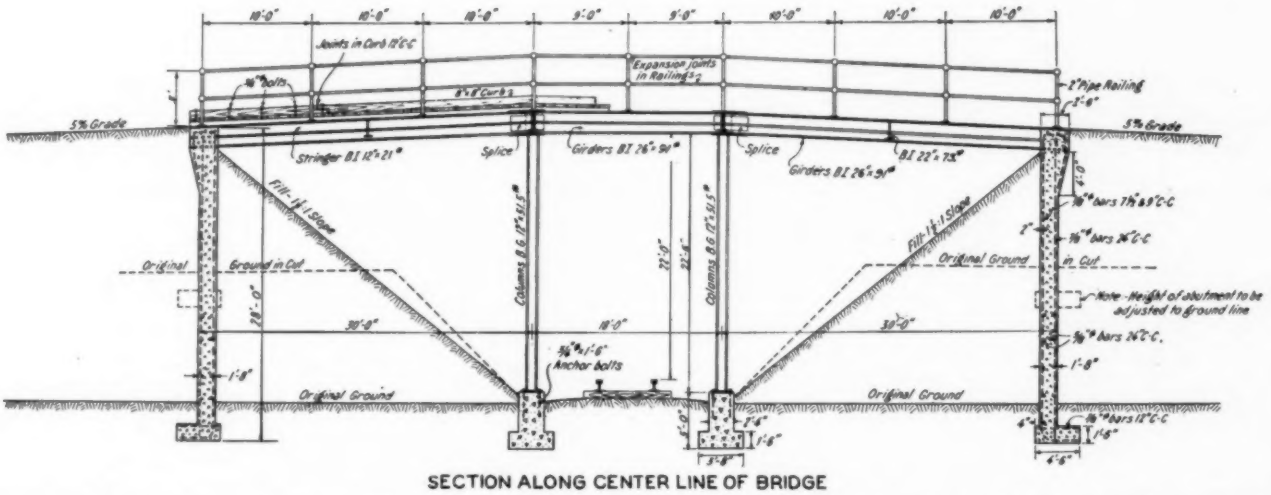
Rigid steel frames with timber floors and concrete abutments over single and double track.

Rigid concrete frames over single and double track.

The last two types are necessarily of the traditional simply supported type. All the types are shown for flat country where the ground level on each side of the railroad is approximately at the level of the track, but the designs may be used for locations where cuts are available for the crossings by simply adjusting the height of the abutment to fit the ground line.

Safe Bearing Power for Foundations.—In using the rigid frame structures, it is important that reasonably unyielding foundations be assured. A settlement of the foundations is more injurious to this type of structure than to the simply supported type. The following allowable pressures are





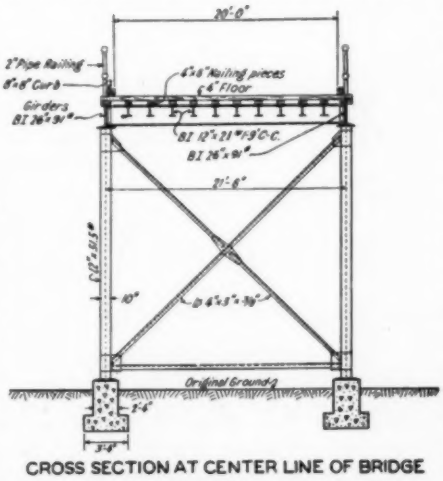
SECTION ALONG CENTER LINE OF BRIDGE

recommended for foundations in different kinds of soils:

	Safe bearing power, tons per sq. ft. Min.	Max.
Alluvial soils	½	1
Clays	1	4
Sand, confined	1	4
Gravel	2	4
Cemented sand and gravel	5	10
Rock	5	Indefinite

Design Features.—In simply supported spans, the abutments must be designed to be self supporting without aid from the superstructure for withstanding the earth pressure from the fill. In the rigid frame designs the abutments may be considered as supported at the foundations, and at the top by the superstructure, thereby greatly reducing the amount of material required for the abutments. However, care should be taken to place the fills simultaneously against each abutment so as to avoid stresses which were not anticipated in the design. It is also advisable to place the fill against the face of the abutment instead of allowing it to roll down on its natural slope as it is dumped behind the abutment.

In the rigid designs, provision is made for stresses caused by the effect of expansion and contraction due to temperature. In simply supported short spans this temperature effect is provided for by expansion bearings; generally by two bearing plates sliding on each other. As a matter of fact, these plates generally become rusted and fail to function, thereby creating injurious stresses in the superstructure and abutments for which no provision has been made in the design. It is evident, therefore, that in simply supported structures many of the disadvantages of the rigid type of structure are present without any of the advantages in economy of design.



CROSS SECTION AT CENTER LINE OF BRIDGE

Fig. 4—Steel Structure Over Double Track

Quantities

Dry excavation	60 cu. yd.
Concrete	64.5 cu. yd.
Reinforcing steel	9,688 lb.
Structural steel	55,272 lb.
Timber	11.702 M. B. M.
Pipe railing	185 lin. ft.

Quantities to be deducted from the above quantities for each foot decrease in abutment height.

Concrete 1.6 cu. yd.; reinforcing steel 213 lb.

Design Loading

2-15 ton trucks with .8 of weight on rear axles. Impact 30%.

Note.—Maximum foundation pressure 1.5 tons per square foot.

The road approaching the grade crossing to be eliminated may be at right angle to the track or it may run parallel to the track. In the first case, it is nearly always advisable to locate the overhead crossing at right angles to the track while in the second case a skewed crossing may be advisable to avoid right angle turns on the approaches. Skewed crossings would of course be special cases although the same general type of structures may be used. Skewed designs are not included in this report.

Principal Requirements of Specifications.—In the following specifications only the principal requirements are given.

Concrete

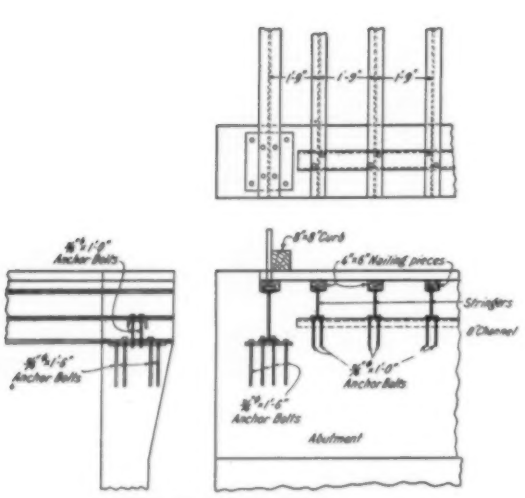
All concrete shall be composed of portland cement, sand, stone or gravel and water.

Cement shall conform to the requirements of the standard specification for portland cement of the American Society for Testing Materials, Serial Designation 69-26.

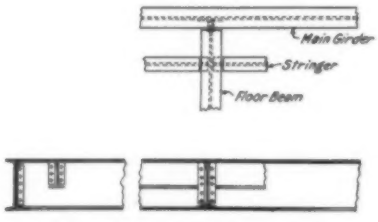
Sand shall consist of clean, hard, durable, uncoated grains free from lumps of clay, soft or flaky particles, salt, alkali, organic matter, loam or other deleterious substances. It shall be well graded from the finest particles to a maximum size of ¼ in.

Coarse aggregate shall consist of broken stone, gravel or blast furnace slag. It shall consist of clean, hard, tough and durable pieces free from organic matter or other deleterious matter. It shall be well graded from a minimum size of ¼ in. to a maximum size of 1 in.

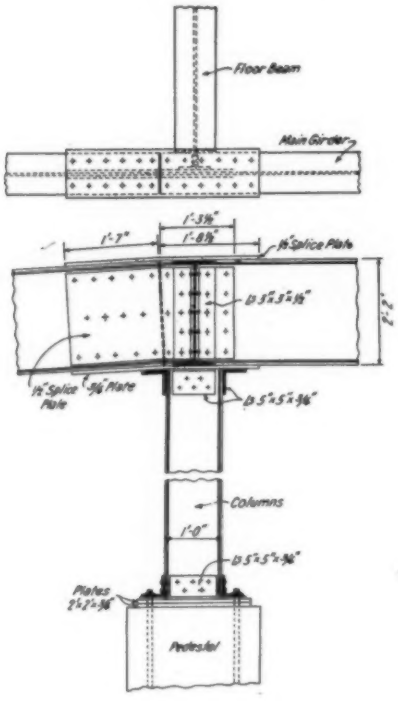
The mixing water shall be reasonably clear

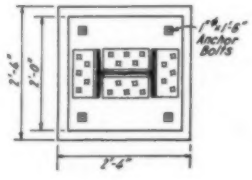


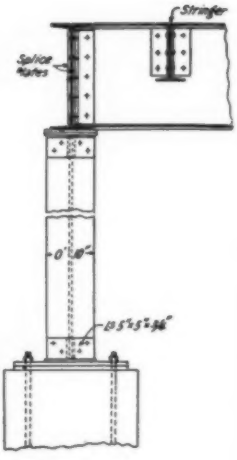
CONNECTION OF MAIN GIRDERS AND STRINGERS TO ABUTMENTS



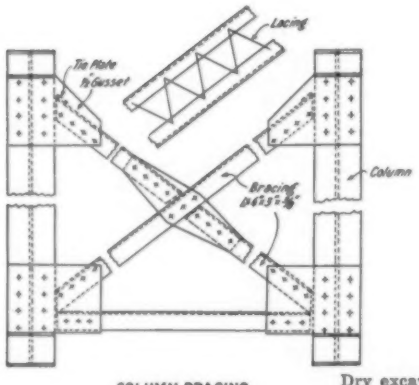
FLOOR BEAM CONNECTION TO MAIN GIRDERS







SPLICE IN MAIN GIRDER AND CONNECTIONS AT TOP AND BOTTOM OF COLUMNS



COLUMN BRACING

Fig. 5—Details of Steel Highway Bridge Over Single or Double Track Railroad

and free from oil, acid or alkali and vegetable substances and shall not be salty or brackish.

The cement, sand and coarse aggregate shall be mixed in the approximate proportions of 1:2:4, but shall contain at least six bags of cement per cubic yard of concrete in place. The proportions shall be varied to insure this cement content. The amount of water in the mix shall not be greater than 6¾ gal. for each sack of cement, including the water in the aggregates. Bulking of the sand due to moisture shall be taken into account in measuring the amount of sand in the mix.

Structural Steel

All steel work shall be fabricated in accordance with the best current shop practice and shall conform to the requirements of the specifications for highway bridges of the American Association of State Highway Officials.

All field connections shall be riveted. Bolting will not be permitted.

Reinforcing Steel

Reinforcing steel shall conform to the requirements of the specifications of the American Association of State Highway Officials for Highway Bridges and Incidental Structures.

Timber

All timber shall conform to the above-men-

Fig. 1—Timber Structure Over Single Track

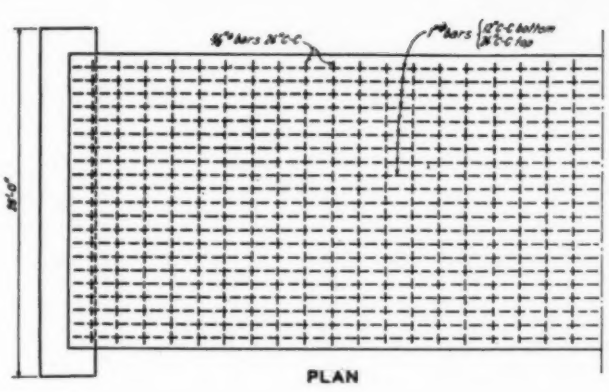
Dry excavation, 43 cu. yd. at	$ 2.00	$ 86.00
Creosoted timber, 32.64 M. B. M. at	120.00	3,916.80
Hardware, 1,000 lb. at	.06	60.00
		$ 4,062.80
Incidentals, 10%		406.28
Total		$ 4,469.08

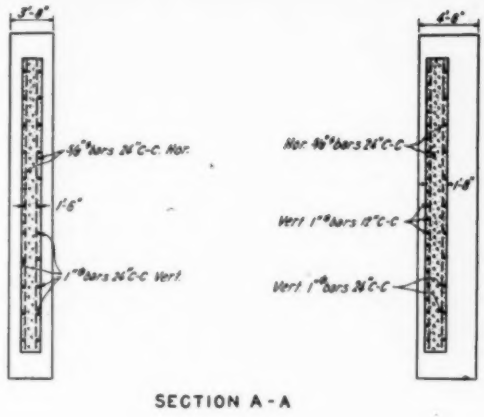
Fig. 2—Timber Structure With Steel Span Over Double Track

Dry excavation, 92 cu. yd at	$ 2.00	$ 184.00
Concrete, 27.3 cu. yd. at	25.00	682.50
Creosoted timber, 34.63 M. B. M. at	120.00	4,155.60
Hardware, 1,000 lb. at	.06	60.00
Structural steel, 14,220 lb. at	.08	1,137.60
		$ 6,219.70
Incidentals, 10%		621.97
Total		$ 6,841.67

Fig. 3—Steel Structure Over Single Track

Dry excavation, 60 cu. yd. at	$ 2.00	$ 120.00
Concrete, 64.5 cu. yd. at	25.00	1,612.50
Reinforcing steel, 9,688 lb. at	.06	581.28
Structural steel, 48.753 lb. at	.08	3,900.24
Untreated timber, 10.09 M. B. M. at	80.00	807.20
Pipe railings, 159 lin. ft. at	2.00	318.00
		$ 7,339.22
Incidentals, 10%		733.92
Total		$ 8,073.14





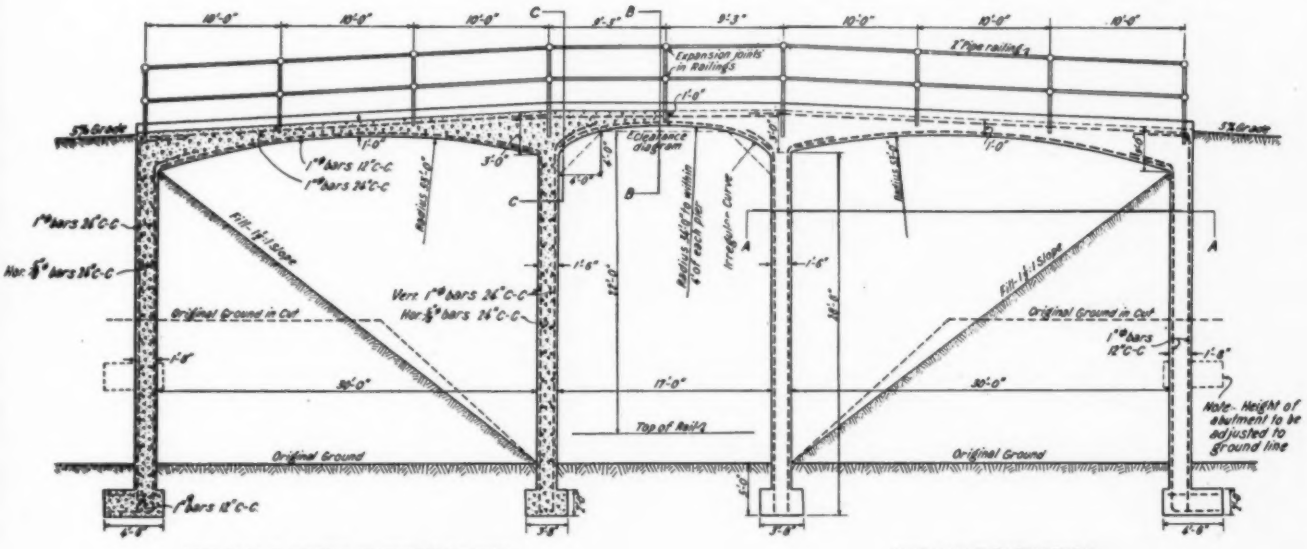


Fig. 4—Steel Structure Over Double Track

Dry excavation, 60 cu. yd. at	$ 2.00	$ 120.00
Concrete, 64.5 cu. yd. at	25.00	1,612.50
Reinforcing steel, 9,688 lb. at	.06	581.28
Structural steel, 55,272 lb. at	.08	4,421.76
Untreated timber, 11.70 M. B. M. at	80.00	936.00
Pipe railng, 185 lin. ft. at	2.00	370.00
		$ 8,041.54
Incidentals, 10%		804.15
Total		$ 8,845.69

Fig. 6—Concrete Structure Over Single Track

Dry excavation, 90 cu. yd. at	$ 2.00	$ 180.00
Concrete, 282.2 cu. yd. at	25.00	7,155.00
Reinforcing steel, 26,790 lb. at	.06	1,607.40
Railing, 168 lin. ft. at	2.00	336.00
		$ 9,278.40
Incidentals, 10%		927.84
Total		$10,206.24

Fig. 7—Concrete Structure Over Double Track

Dry excavation, 90 cu. yd. at	$ 2.00	$ 180.00
Concrete, 303.4 cu. yd. at	25.00	7,585.00
Reinforcing steel, 131,877 lb. at	.06	1,912.62
Railing, 185 lin. ft., at	2.00	370.00
		$10,047.62
Incidentals, 10%		1,004.76
Total		$11,052.38

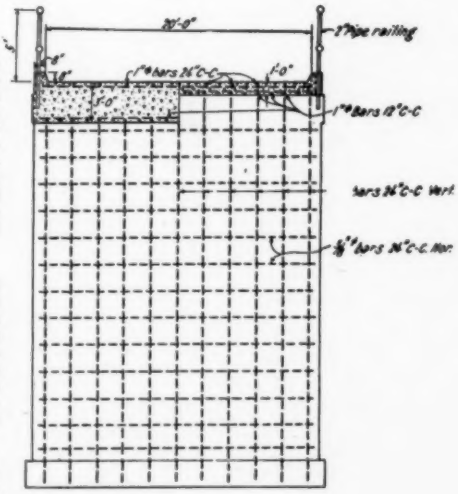


Fig. 6—Concrete Structure Over Single Track

Quantities

Railing	168 lin. ft.
Dry excavation	90 cu. yd.
Concrete	286.2 cu. yd.
Reinforcing steel	26,790 lb.

Quantities to be deducted from the above quantities for each foot decrease in abutment height.

Concrete 3.2 cu. yd.; reinforcing steel 298 lb.

Design Loading

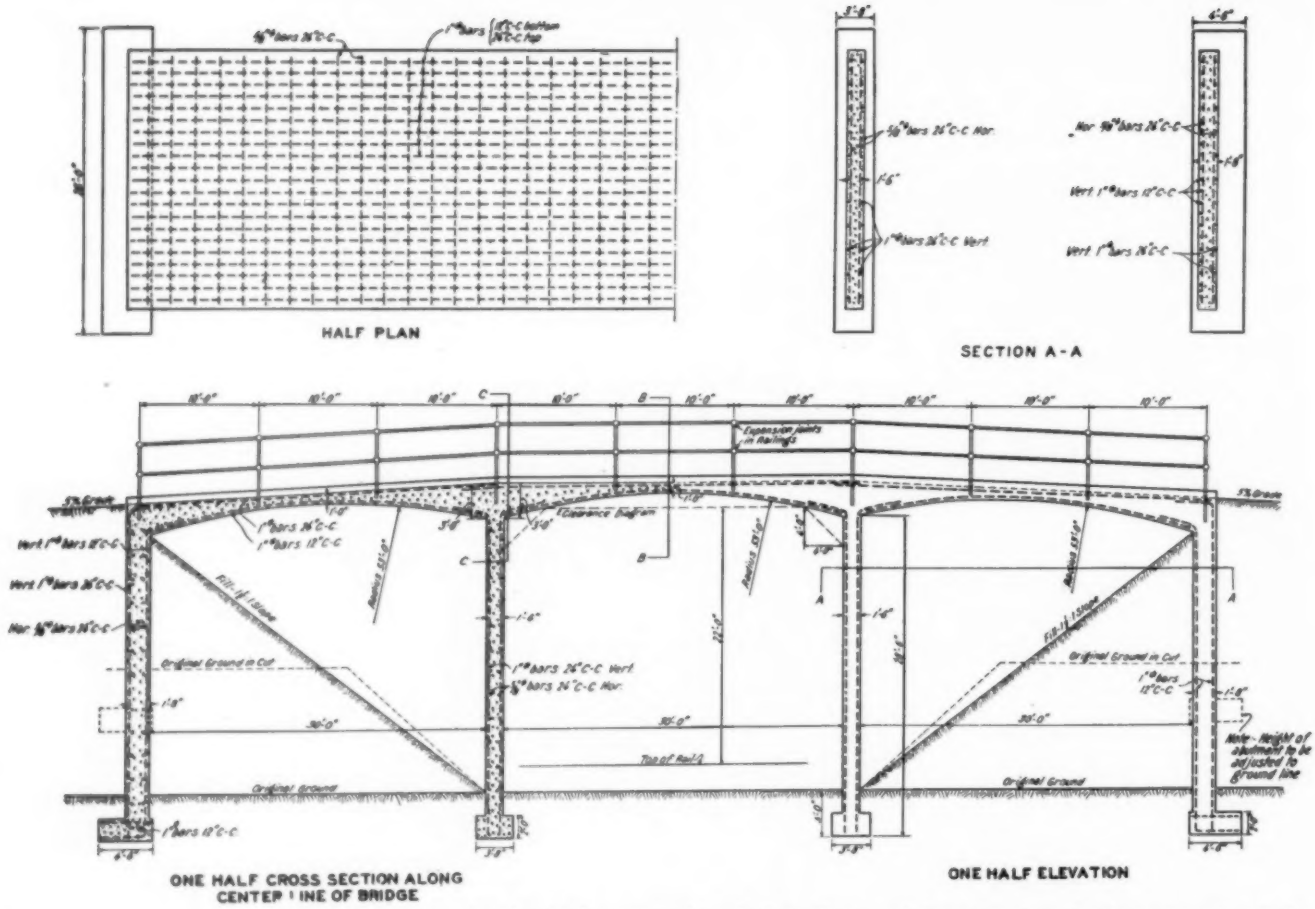
2-15 ton trucks with .8 of weight on rear axles. Impact 30%.

Note.—Maximum foundation pressure 2.0 tons per square foot.

tioned specifications of the American Association of State Highway Officials.

Estimates of Costs.—The following estimates of cost of the several types of crossings are based on average prices and should be modified to conform to the prices prevailing in the locations in which they are used.

As an indication of the relative economy of this type of structure it is pointed out that a concrete structure designed as simply supported spans on the usual type of piers and abutments with wing walls would require approximately 30 per cent more concrete



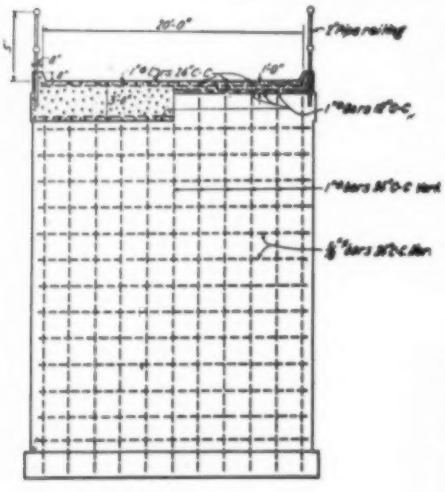


Fig. 7—Concrete Structure Over Double Track

Quantities

Railing	185 lin. ft.
Dry excavation	90 cu. yd.
Concrete	303.4 cu. yd.
Reinforcing steel	31,377.3 lb.

Quantities to be deducted from the above quantities for each foot decrease in abutment height.

Concrete 1.5 cu. yd.; reinforcing steel 213 lb.

Design Loading

2-15 ton trucks with .8 of weight on rear axles. Impact 30%.

Note.—Maximum foundation pressure 2.0 tons per square foot.

and reinforcing steel and cost about 25 per cent more than the rigid frame type.

It should be remembered that these plans must be approved by the railroad company over whose tracks the structure is to be built.

Upon request, further information concerning this subject will be furnished by the American Road Builders' Association, National Press Bldg., Washington, D. C.

Routing Through Traffic in Cities

The State Highway Department of Minnesota is designing standard signs for use in municipalities where truck highways go through the residence districts or hit only the outskirts of the town. The signs will be placed on an alternate route leading through the business district and back to the trunk highway.

"We have long recognized that traffic coming into or through a town over a trunk highway is of two kinds, buying traffic and passing traffic," says Commissioner C. M. Babcock. "To route a trunk highway with all the passing traffic through the congested portion of a city simply adds to the congestion, leads to accidents, and often tends to keep the buying traffic away. But very often the business men fear that if the trunk highway does not come through the main street they will lose some of the buying traffic.

"It is true that many people, especially strangers, hesitate to get off the trunk route for fear they will lose their way or have to double back. By marking an alternate route with standard signs, it will be easy for drivers to find their way through the business district and back to the trunk highway. This will give such towns the benefit of any buying traffic that comes over the trunk routes, without having the through traffic congest the business district."

When the business district is some distance from the trunk route, a sign with the name of the city, an arrow, and the words "City Loop" will be used where the alternate route leaves the trunk highway. Along the route through the city only the words "City Loop" will be used, with the standard "R" and "L" signs at turns. Where the trunk highway is only a block or two from the main street, signs with the words "Business District" and an arrow, may be used. All signs will be in black and white, conforming to the standard highway information signs.

The signs will be furnished by the department, but their use will be sanctioned only on streets which are reasonably well maintained by the municipality. They may be used in any city or village where the trunk highway already is separated from the main business streets, and in the future in any municipality when a permanent route is designated which does not go through the business district.

County Highway Traffic Control and Regulation

An Outline of the Problem, Together with a Description of the Information Required to Determine Upon Logical Method of Control

By HAWLEY S. SIMPSON

Research Engineer, American Electric Railway Association

THE county as an area in which traffic control should be centralized is an idea rather new in traffic regulation; control of traffic throughout a county ordinarily being delegated to the individual municipalities through which a highway runs. This latter plan results in different types of traffic regulation, differing degrees of enforcement and various kinds of signal systems, with the accompanying confusion. As an example, I am familiar with an important heavy traffic artery which traverses eleven different jurisdictions in as many miles. Such a condition tends to produce the very antithesis of uniformity, generally acknowledged to have a very considerable effect on safety and efficiency of traffic movement. Traffic circulation is so all important to the public that regulatory and enforcement activities over as large an area as is practical should be delegated to but one responsible, well-informed, non-political director, rather than to many elected officials, who, however earnest and well meaning, cannot possibly be as well versed in modern methods of traffic facilitation as one whose training and entire time is devoted to the single activity.

Why County Is Logical Enforcement Area.—Uniformity of laws and regulations is a first step of great importance, but the greatest ultimate good therefrom will only be achieved when a higher degree of uniformity of enforcement and regulatory devices becomes a fact. This, in itself, almost necessitates the introduction of larger enforcement areas than are now common. Naturally, then, the question arises as to why the county should be chosen as a logical enforcement area. County government originated in the United States with the first settlers and was carried by them in varying forms to all but one state in the Union. States are sub-divided into counties in numbers ranging from 3 to 253, whose 1920 populations ranged from 65 to over 2,500,000, varying in area from 25 to 20,175 square miles, the latter approximately the area of the combined states of Massachusetts, Connecticut and New Hampshire. County boundaries were laid out many years ago as politically expedient or according to rigid Federal dictates; seldom with much regard to natural geographical conditions; and certainly with no consideration of the areas which now exist to all intents and purposes as economic entities. Notable among these examples of illogical imaginary boundaries are those of the cities of New York and Chicago. The area defined as "New York and Its Environs" embraces parts of three states, all of 17 counties, and unnumbered other overlapping municipal jurisdictions. The "Chicago Metropolitan Area" as defined by the United States Cenus Bureau includes parts of two states, all or parts of 6 counties and many cities, towns and villages. From a logical viewpoint, such areas might well be organized into single traffic zones.

Coordination of Traffic Activities.—I do not think it visionary to hazard the guess that there will be an increasing demand for the organization of such traffic zones under a single authority to coordinate the traffic activities of the various jurisdictions constituting the area. This might in some cases be done voluntarily, but probably in the majority, enabling legislation would be required. At least one legislative commission is at present studying this and other related regional problems, and such attempts as centralization of authority over matters that are of wide general importance, rather than purely local in scope will be watched with interest. Regardless, however, of the lack of definite legislation, in many jurisdictions it is already possible for particular areas to very profitably join forces through the medium of a central and existing authority, such as the county or the state, to the end that all or parts of the traffic problem may be more uniformly considered. Examples of such activities may already be seen in the state of Massachusetts, where a traffic engineering bureau has been established in the State Department of Public Works wilth full control over traffic regulatory measures throughout the state. Essex County in New Jersey is conducting in a similar work, having assumed, on the county road system, by legal permission, all the rights relating to traffic control formerly delegated to 22 municipalities. To date all of these duties have been undertaken except the actual policing of the streets, and sometimes in 1930 this will very probably be taken over.

In this particular case the traffic force will receive some designation other than police, and will act as highway "guards," devoting their time to the assistance and facilitation of traffic and motorists in a serious attempt to relieve congestion, with only secondary attention paid to the matter of arrests. It is felt that the motorist will value such an approach to this problem and that by cooperative effort more will be accomplished than if the attitude is taken that every motorist is a potential, criminally intentional law breaker. The average driver is a safe driver. The average infraction of a traffic regulation is unintentional and unpremediated, yet police departments have to this day persisted in viewing the breaking of a traffic rule as of almost the same degree of seriousness as the breaking of a safe, or if not, then as an excellent opportunity for the display of a few bits of well chosen sarcasm. We feel that a reversal in this position should promote a very decided improvement in obedience to regulations, and incidentally in traffic safety, as it must be that a portion, at least, of accidents are occasioned by over nervous operators who shake at the sudden appearance of a traffic officer or the sound of his whistle.

County Problem Differs from That of City or State.—We have thus far been discussing the general problem of traffic control in various areas, whereas the specific subject under consideration is that of traffic regulation and control in a county. It appears that a county problem is somewhat different from that of either a state or a city. State highway traffic is composed, in general, of a preponderance of long haul, high speed traffic, and particular attention must necessarily be paid in the actual construction of the highway to the elimination of as many deterrents to traffic as possible. State highway departments are usually able to build new and by-pass highways in new locations and thus to expand the system as rapidly as finances will permit, without causing serious economic disturbances. The condition in the average city is much different. The streets and highways were laid out according to a rigid pattern at least 100 years ago by persons who often were possessed of marvelous vision, but who by no stretch of imagination could have hoped to conceive the three dimensional growth of a modern large city. The street system has thus become an almost inflexible one to which additions can be made only to a very limited extent and even then at the risk of destroying an enormous volume of ratables and seriously disrupting the orderly conduct of business for long periods of time. It is quite true that important new highway construction of this character builds up large valuations in the immediate neighborhood,

but generally at the expense of the average tax payer who may very probably gain very little therefrom, and when the whole project is completed, a great untapped supply of motor vehicles is released and the unit of congestion returns to precisely the same point as before the improvement. This is the unfortunate condition in which every large city finds itself and is the result of permitting indiscriminate use of such streets without considering how they could be most economically employed.

The county is in a favorable situation, usually being located somewhat in the medium between state and city. Its problems in some respects are akin to those of the state, and in others, to those of the city, suffering in common with the latter, a very general case of hardening of the traffic arteries. This condition allows the county an excellent opportunity to put into practice a greater variety of devices and methods for the control of traffic than either of the other two governmental divisions.

What Traffic Regulation Should Include.—As affecting any governmental jurisdiction, traffic control and regulation ordinarily contemplates only those actual means of regulating vehicular operation over an existing highway. To my mind, this is a most erroneous assumption. Traffic facilitation is dependent upon many factors of more vital importance than the mere use of a "stop and go" signal, the introduction of a parking regulation here, or a "no left turn" prohibition there. Traffic regulation, in its more general sense, should include considerations governing the actual location of the highway to best serve the contiguous territory; the construction of the highway of such a capacity that it will be ample for the probable traffic demands over a reasonable period of time; the acquirement of a sufficient right of way to economically accommodate the inevitable increases in traffic; the design of the critical controlling points of limiting traffic capacity, such as the intersection, the use to which adjoining property is to be put; the type of vehicles to be used on the highway, and other more detailed matters. In short, the necessity for traffic control is occasioned because the existing highways were never built for the requirements of modern day traffic, little consideration having been given to these items just mentioned. Mr. Chas. R. Thomas has aptly said, "It is only within the last few years that road engineers and officials have begun to study traffic as a preliminary to highway construction. In the past traffic was regarded somewhat as a consequence of road construction, and little study was given to the traffic demands." Yet, even in the light of present knowledge and experience, streets and highways are today generally being constructed along the same lines as before the widespread use of motor vehicles. Certainly, important changes have been made, such for example, as in ruling grades, widths, types of surfacing and drainage, yet in a large measure they differ but very slightly from horse and buggy roads. Economic traffic facilitation demands a consideration of city planning, zoning, mass transportation facilities and economics of highway location. These matters are too seldom given their warranted consideration and the result is the increasing necessity for the use of regulatory devices which are but palliatives—not cures.

Traffic control and regulation presupposes a knowledge of the problem at hand. This information is usually largely gained through individual, isolated and haphazard observations. Accurate information can only be obtained by the intensive and continuing collection of factual data gathered by trained observers. Comparisons of conclusions based on these two methods of gathering information disclose differences so radical that one is led to wonder whether money expended for highway construction and traffic control under the haphazard method of statistical collection is not in a measure wasted. Due to the previously mentioned fact that additional facilities tap a never ending supply of motor vehicles the new construction is usually used to reasonable capacity, but from an economic standpoint it is questionable if such facilities can possibly provide the same return on the money expended as if a program based on accurate information had been followed.

A brief general outline of the information which it is essential to collect in order to analyze the use of a county highway system to determine upon logical methods of traffic control follows:

Origin and Destination Studies.—The most economical routing of traffic may be studied by surveys of the origin, existing routes and destination of vehicular traffic. Only through the collection of such information can a logical plan of street construction be determined upon. Studies of such surveys show that the most absurd routes are often used to go from point to point, either for want of a better route, or because of lack of knowledge of the shortest and best way. A considerable percentage of all traffic on our most congested streets is made up of vehicles which have no business thereon and which could, if a better route were established, be diverted around the congested sections. Lack of uniform, well placed and legible directionary signs is a contributing factor to the concentration of traffic on the better known routes, while adjacent parallel streets of high potential capacity are all but neglected.

Speed and Delay Surveys.—A deplorable lack of information exists relative to the actual average over-all speed of all street vehicles. Upon an average business street surveys show the over-all speed to be from 50 to 75 per cent of the normal running speed. Greater highway efficiency can be obtained, not by increasing the maximum speed, but by a reduction in delays so that the average speed may closely approach the running speed. This necessitates extended field surveys showing in detail the speeds over various sections of the route, and the amount and actual cause of each individual delay in order to determine upon suitable remedial measures. In surveys of this sort it will be found that the largest portion of all delays are caused by traffic signals, in some cases as high as 85 per cent. To some extent these delays are unavoidable in order to permit cross traffic to move with reasonable dispatch and safety, yet a very large percentage of these delays will be found absolutely unnecessary. Special detailed studies of those intersections and areas where the delays are largely unnecessary or unnecessarily large, should be the first point of attack when the information thus collected is analyzed.

Such studies are absolutely essential in planning a traffic signal system, for the type and timing of the signals is largely determined by the vehicular speed. After the introduction of the system the speeds should again be checked to determine whether any benefit has been derived and to correct the timing where it has not proved satisfactory. Periodical checks should be conducted on all streets in the system, particularly the signalized areas, to observe the effect of changing traffic characteristics and to revise the signal system accordingly.

In Essex County these surveys have been most successful in picking up congestion points and in determining the speeds for which progressive signals should be designed and operated. In one very congested area, the average speed was increased 49 per cent by the introduction of a progressive signal system replacing isolated manual control and by changes in certain of the traffic regulations. This is an exceptional case, and if surveys before and after signalization show no decrease in the average speed we can well be satisfied, and even very minor speed increases can be viewed with satisfaction. That signal systems often fail to increase average speeds very materially is due to their inflexibility and inability to conform to the ever changing traffic demands. Signal controllers are now being built which are designed to overcome this difficulty and when in more general use, will largely remove the objections to automatic signaling. But considering only the more common types of signal systems, the greatest difference is possible in the results accomplished. It is much easier to design a signal system to stop traffic than to move it, and unfortunately too

many systems have this effect. An insistent demand that traffic signal systems be designed in accordance with observed speed data should be made with further insistence upon periodical checks to insure the continued high efficiency of the system.

Intersection Traffic Surveys.—A continuing inventory of traffic volume should be made at every important intersection in the county, whether it is on a county road or not. Municipal authorities will in most cases be glad to cooperate in the collection of this information for their own particular streets. Every movement of every vehicle should be recorded and summed up at intervals of 15 minutes, 30 minutes or one hour. It is not essential to classify vehicles by types at the intersection unless a very peculiar condition exists, as in general, classification counts can be better made between intersections at a few selected points.

Present practice as to the length of time over which intersection counts should extend to be of practical value, is not uniform and the period may vary for different traffic characteristics. Common periods are as follows: 7:00 A. M. to 11:00 P. M.; 7:00 A. M. to 6:00 P. M. and 8:00 A. M. to 6:00 P. M. When the intersection counts do not extend over the full 24 hours, it is desirable to make 24-hour counts of key streets to obtain the relation between the total daily traffic and the traffic in the period counted. On very important streets, 24-hour counts for the entire week are valuable to obtain the diurnal variation. Special counts of heavy traffic thoroughfares on Saturdays, Sundays and holidays, are valuable in determining peak loadings and often actual capacities. Such peak conditions are of irregular occurrence, and we do not believe they should be used in designing a street system with its related traffic control. These should be based on average weekday conditions, with special control features for infrequent and extreme conditions.

The information for the entire area should be plotted on a "traffic flow map," forming a picture of the traffic loading throughout the district. Such a map is of considerable value in determining the necessity for the institution of particular regulations at intersections, the necessity for the erection of traffic signals, the introduction of a step street system, and other related matters.

Accident Analysis.—The collection, compilation and analysis of accident records is essential to a well considered traffic program. General statistics covering all street accidents should be computed monthly from the individual accident reports of each municipality, and covering every street in the area rather than only the county system. These are of value in calling public attention to the situation, but are of negligible value to the engineering and public safety official in determining upon means for accident reduction. For this purpose, what is known as a "location record" is most valuable. Each intersection in the area should be included in the "location record" which is usually a card file. On the intersection card should be noted the serial number of each accident, and when from 5 to 10 accidents have occurred at any intersection it may be considered as worthy of a detailed investigation.

The investigation should study and group the accidents in every possible manner, by hours, directions, type, month, day, age of pedestrians, and in every other conceivable way, and upon the study of these analyses will be based the recommendations, which may range from the mere trimming of trees or shrubs to a complete reconstruction of the intersection; the placing of traffic signals, the placing of warning signs, changes in parking regulations, the presence of patrolmen during certain hours, the rerouting of school child traffic, relocation of street lights and any of a dozen other possible changes.

With these and various other and more detailed data, such for instance as parking studies and mass transportation surveys, which time precludes discussing, consideration should be given to a traffic plan.

The Traffic Plan.—The origin and destination surveys will indicate the normal directional movements of traffic and permit a decision as to those routes which should be considered as the major traffic arteries. The location of by-pass routes around congested sub-centers to relieve particular areas can be determined with considerable accuracy and with assurance that they will produce the greatest possible benefit. If it becomes necessary to obtain public approval for the issuance of bonds to cover this construction, such approval may be more readily obtained when an actual picture of the existing and probable future conditions is presented. Consideration may then be given to routing traffic over existing streets of adequate width which will enable them to reach their destination in the shortest possible time, rather than over the shortest route. Analysis of this problem will reveal some very excellent methods by which all traffic may be facilitated by a greater use of little known streets, thus spreading the traffic load. Studies of these existing by-pass or alternate routes should be made to determine the necessity for physical improvement and the placing of adequate direction and caution signs so that the route is attractive to traffic and invites its continued use. Many attempts have been made to divert traffic over minor streets of characteristics such that no operator would consider making more than one trip. The result has been that such alternate routes are in great disfavor, through no fault in the selection of the route, but because no attention was paid to the psychological reaction of the motorist.

The selection of the major routes being determined, studies are required to determine the probable right of way requirements. This is a matter of the greatest importance for upon the proper selection of widths depends the future ability of the system to cope with the demands made upon it. In such a plan, careful consideration must be given to the provision of sufficient width to accommodate motor vehicle traffic, mass transportation vehicles, pedestrians and utilities, not to mention the important matter of the esthetics and appearance of the future highway. To too great an extent are sidewalk widths and grass plot areas with beautiful trees being sacrificed to the demands of the motor Juggernaut. This may undoubtedly be necessary on highways not designed for modern needs, but the highway of the future should contemplate the desirability of a retention of some semblance of beauty, and adequate provision of the safety and convenience of the pedestrian.

The paved area in the county highway plan should be based upon present and reasonably sure future traffic needs. The hour of maximum traffic concentration as determined from the intersection surveys should be used in determining the present requirements. Lacking statistics showing the past increase in traffic volume from which to estimate future growth, it is safe to say that for a time at least, traffic in general will continue to increase at a rate not exceeding the rate of increase in motor vehicle registrations and not less than the square root. The present rate of increase will probably decrease after a few years, but assumptions as to the future are liable to prove very erroneous, and should be confined to comparatively short periods. But in this respect, it is never too late to begin, and traffic studies begun in 1930 should by 1935 give a very definite evidence of the probable immediate trend of increase.

The required width of pavement between intersections can be computed from the traffic flow figures, but the capacity of the intersection, the controlling critical point of any street system is the point to which the greatest amount of attention should be paid. A determination should be made as to the ultimate type of traffic control at every important intersection, which may be any of the various methods of separation of grades, a traffic circle or traffic signal control. The acquisition of property sufficient to permit separation of grades or the construction of a traffic circle should be made while property values are low, and years before such construction could be economically justified. Where for any reason

neither a separation nor circle will be possible, resort must be had to traffic signal control. Traffic signals arbitrarily and definitely reduce the capacity of the two streets to less than 50 per cent of their potential non stop capacity, a condition not inherent in the two previously mentioned plans. This being true, careful consideration must be given to right of way and pavement widths at an intersection.

Stated very generally, at the intersection at grade of two equally traveled streets, the pavement width at the intersection should approximate twice the available movement width between intersections in order to compensate for the known loss of time due to signaling. Intersection pavements of such widths designed for future capacity traffic will require pedestrian refuges in their centers, adding still more to the requisite right of way width at the intersection. In short a highway should be designed much as a pipe line or sewer system, with capacities sufficient for the probable demands, and not along rigidly straight property lines arbitrarily determined.

These are the more fundamental and underlying of the problems of traffic control, which adequately met, will delay the evil date at which prohibitory measures become necessary. Traffic signal systems are of this class but are essential in the traffic control plan of the county. They may be designed to fit quite closely the traffic needs if the previously described information has been accurately gathered. The entire area should be considered as a unit, and a system for the entire county should be decided upon, but not immediately installed. Installation should be first made at key points and along major arteries designed to achieve as nearly as possible the Utopian condition of non-stop movement, perhaps not attainable, but certainly approachable. The ultimate scheme should provide a system of signaled routes with the preliminary installations forming the ground work and becoming a part of the larger plan when finally completed. If a plan is previously determined upon, but signals are merely installed if, as and when requested by the public, the responsible official will some day come to the realization that no system exists, and rather than having relieved congestion, his well meant plans may easily have had the opposite effect.

One of the major controlling factors in traffic signal location is the vehicular volume, which is determined directly from the intersection surveys. On this one point, engineers are not agreed, and perhaps it is well that they are not, for particular cases require particular treatment and a too rigid standardization might not be beneficial.

Acknowledgment.—The foregoing is an abstract of a paper presented Feb. 11 at the 16th Annual Conference on Highway Engineering at the University of Michigan.

Traffic Separation at Railroad Grade Crossings

Low cost carefully planned structures for separation of traffic at railroad grade crossings or highway intersections are urged in a report of the grade crossings committee of the American Road Builders' Association.

It is pointed out that many such structures that were built during the past decade are now inefficient for traffic needs. Some are too narrow, others have dangerous curves at approaches or over the structure.

The committee has been at work for the past year on a study of low cost grade separations, believing that the cost alone has retarded the elimination program which on every hand is regarded as vital to traffic safety. Relocation of highways is favored in instances where it might be more economical and result in better alignment.

Chairman Morris Goodkind, Bridge Engineer of the New Jersey State Highway Commission, declares that danger to life is three and one-half times greater at grade crossings than on other parts of the highway system and recommends the construction of the maximum number of grade crossing eliminations from railroad, state and local funds available.

Statistics cited by the committee show that densely populated areas have greater need of grade separations of intersecting highways as well as of railroads and highways at grade crossings.

In New York, in 1928, accidents at intersections were classified as follows:

	Total	Fatal	Non-fatal
Rural intersections	634	27	607
Street intersections	40,964	635	40,329
Railroad crossings	208	101	107

During the first half of 1929, figures in the first two groups increased considerably over those for railroad crossings. In 1925, the total number of accidents at street intersections was 20,398 and at railroad crossings 148, so that in three years the former increased about 100 per cent and the latter about 40 per cent.

This higher rate of increase was thought to be due to the fact that elimination of railroad grade crossings has been going on at a faster rate than those of intersecting highways. Elimination of both is necessary in the design of modern roads to increase their safety and capacity.

Out of a total of 675 motor vehicle fatalities in North Carolina in 1928, 54 deaths, or 8 per cent, were caused by collision with railroad trains, while an equal number of fatalities occurred at street intersections and 25 others at rural intersections, according to William L. Craven, State Bridge Engineer.

C. B. McCullough, Bridge Engineer of Oregon, declares that in ninety-nine cases out of a hundred where damages are sought for railroad crossing accidents, if the plaintiff had stopped, looked and listened as told by the standard warning sign he wouldn't have been on the crossing at the time of the accident, so that the very fact of the accident makes out a prima facie case against him.

"In spite of their rather impregnable legal position," he continues, "the railways of the United States have been very generous in their settlement of damage claims for grade crossing accidents and not only in this regard, but in the matter of eliminaing grade crossing hazards upon their own motion, many of these companies have gone so far as to rather shame the highway group upon whose doorstep the problem really belongs."

The splendid progress made by Georgia in grade crossing eliminations on the state highways is revealed in a statement by Bridge Engineer Searcy B. Slack that the number of 781 grade crossings in 1918 was reduced to 415 by the end of last year. Of these eliminations, 297 were by re-location, 56 by bridges over the railroads, and 13 by underpasses.

Other than the good and sufficient reason of reducing fatalities at grade crossings, Chairman Goodkind declares that anoter distinct advantage gained by crossing eliminations is the facilitation of traffic.

"Just as the standing of a railroad in the minds of its patrons depends on the safety and efficiency of its service," says Goodkind, "so is the value of a highway measured by the same characteristics, and all efforts should be made to remove the hazards as quickly as possible."

Growth of Motorcoach Operation

At the beginning of 1928 the route mileage of common-carrier motorcoach operations was about four times the mileage of electric railway track, or three-quarters of the track mileage of the steam railroads, according to figures given by F. J. Brackett in a paper presented at a joint meeting of the Pennsylvania Section of the Society of Automotive Engineers and the Engineers' Club of Philadelphia. At the end of 1928 common-carrier motorcoach route-mileage was more than seven times the mileage of electric railway track, or more than one and one-quarter times the track mileage of the steam carriers.

In the four years preceding 1928 the number of motorcoaches operated in the United States increased from 53,000 to 86,000. Motorcoach operation is fast becoming a part of big business. At the beginning of 1929, 322 steam and electric railroads were operating 11,318 motorcoaches, and 45 companies operated 22.65 per cent of all the common-carrier motorcoaches of the United States.

Light Surfaced Roads in Kansas

Methods and Costs of Maintenance of Sand-Gravel Surfaces

By IRA E. TAYLOR

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THE development of the sand-graveled road surface in Kansas was begun in 1925 when the legislature enacted the gasoline tax which provided sufficient funds for intensified maintenance and the construction of a limited mileage of light type surfaced roads.

While the roadwork on the state system was handled through the individual counties a large number of projects was constructed with sand-gravel, or chats for the road surface, but these projects were generally not connected with those in adjacent counties. The maintenance on these individual projects was not particularly difficult. A section of highway comprising 6 to 10 miles was assigned to a team patrol, and an outfit of this kind produced very favorable results. The surface treatment prevented rutting under wet weather conditions due to the practically impervious crust built up under constant maintenance. The patrolman had little difficulty in reclaiming his road surface after a rain because the traffic was light and did no particular damage to the highway.

As soon as the advantages of light type surfaced roads became apparent to the traveling public, a demand was created for a connecting system of such highways and a large number of counties were persuaded by the state highway commission to concentrate their work on a particular highway which would join with that being undertaken in the neighboring counties.

In 1929 the state highway commission assumed direct control of the state system in Kansas and immediately set out to build the necessary connections on a number of highways that had already been partially surfaced.

Heavy Traffic Increased Maintenance Need.—Following these two movements a rapid increase in traffic could be noted on those roads which extended between market centers, or formed a part of the interstate connections for through traffic. It is only during the past two seasons that the problem of maintaining sand-gravel and chat surfaces has presented itself as being one of the most serious and expensive of highway maintenance in Kansas. Heavy traffic during extended wet or dry weather periods is very detrimental to the sand or chat surfaces, as they are being built and maintained in this state.

A long period of rainy conditions causes the road to become rutted under heavy traffic and in several instances the impervious surface has broken through and the road then becomes no more serviceable than an earth highway. However, it has not been difficult to rebuild the surface under maintenance methods with additional material.

The light surfaced highway carrying heavy traffic during dry weather periods such as occur in Kansas during the latter part of July and the month of August become pitted and extremely dusty. It is necessary in many instances to scarify the road surface before it can be placed in a satisfactory condition for comfortable traveling.

A State Highway in Western Kansas Showing the Smooth Sanded Surface, Fine Uniform Width, Free Unobstructed View and Long Elevated Curve

Traffic Capacity of Sand-Gravel Road.—It is generally conceded that a sand-graveled road is suitable for a maximum traffic of 350 to 500 vehicles per day. A large number of highways in Kansas of these lighter types are carrying in excess of this economical maximum. It is probably due to this excess traffic that the maintenance cost on sand-gravel and chat roads has been steadily mounting during the past two years. The purchase of motorized equipment has been necessary so that maintenance operations can be handled quicker and more effective results be obtained due to the ability of the machine to re-shape surfaces damaged by extreme traffic conditions. The cost per mile of the heavier equipment compared to that resulting from the use of the team patrol is not materially increased.

Under motorized maintenance a larger mileage can be assigned to each outfit, and while the total cost of operation is higher the rate per mile does not exceed the team patrol methods. The large items of maintenance costs on heavily traveled sand-graveled and chatroads is that of material replacement.

Cost of Resurfacing.—During the year of 1929 approximately 2,325 miles of light surfaced roads were maintained on the Kansas State System. Approximately 723 miles of these roads were re-surfaced at a cost of $633,883.91, making an actual replacement charge of $876.96 per mile. This represented an average replacement of 320 cu. yd. of material on each mile actually re-surfaced. The average cost for resurfacing by divisions varied from $463.86 to $1,238.07 per mile, and the quantity of material from 210 to 465 cu. yd. per mile. This wide variation is due primarily to one or more of the three following conditions.

1. The amount of material originally placed on the road was not sufficient.
2. The material used was of an inferior gradation.
3. Abnormally heavy traffic for this type of surface.

The highway commission has ordinarily taken the stand that 800 cu. yd. of material should be placed on the road as a construction project for the first application. In many cases considerably less than this amount was included in the first application, and, of course, a larger replacement was needed at an earlier date than on those roads receiving a full quota of material.

When the light type surfaced road

was first constructed it was believed that most any gradation of material could be used for surfacing. However, after the first year or so it was ascertained that the finer materials were not as suitable as those of coarser gradation, and the same quantity applied on the highway would not serve for as long a period as when the coarser materials were used. In many cases it has been necessary to resurface with practically the same yardage as was originally placed on the highway where the finer sands were used.

Heavy traffic exceeding 350 vehicles per day will consume an amount of material which is practically relative to the number of vehicles using the highway. This material is lost by high speed traffic during dry weather and absorbed by the road surface during wetter period when traffic is heavy. It is, therefore, impossible to foretell in all cases just what replacements will be required for a future period.

Resurfacing Activities in 1929.—Table I indicates the resurfacing activities of the state highway commission by divisions for the summer season of 1929, covering the dates April 1 to Oct. 1, inclusive.

It will be noted from these data that the average replacement per mile covering the entire mileage having a light surface is 95 cu. yd. per mile. The average cost of this material during the 1929 season was approximately $2.85 per cubic yard delivered on the highway. The average cost per mile over the entire mileage was $272.67. It is believed that the material required for replacement will gradually increase each year, and this theory is sustained by the estimated requirements for the 1930 season.

Estimates for 1930.—The division engineers' forecast for sand-gravel replacement during 1930 varies from 198 cu. yd. per mile to 382 cu. yd. per mile indicating an average of 285 cu. yd. per mile for the whole state. It will be noted that this is less than the 320 cu. yd. for 1929, but the 1930 program covers the resurfacing of a little over 1,614 miles while that of 1929 is for the resurfacing of approximately 723 miles, using a total of 3,000 miles of light surface roads which will be under maintenance during 1930, the average replacement for this mileage is approximately 155 cu. yd. per mile. The estimated cost for material in 1930 is figured at $2.60 per cubic yard delivered on the highway and with the estimated quantity of 155 cu. yd. per mile, the cost of replacement will be approximately $400.00 per mile.

Table II—Estimated Sand Replacement Requirements for 1930

Division	No. Miles	Cu. Yds. Replacement Material	Estimated Cost	Av. Cu. Yds. Per Mile	Average Cost Per Mile
1	378.7	74,952	$ 217,684.80	198.0	$ 574.80
2	305.3	114,102	308,000.00	373.7	1,008.80
3	283.75	74,275	192,150.00	261.8	677.18
4	287.5	109,900	260,615.00	382.0	906.48
5	225.5	62.725	141,391.00	278.0	627.00
6	133.7	27,070	76,419.60	202.0	571.57
Totals and Average	1,614.45	463,024	$1,196,260.40	286.6	$ 740.97

It is anticipated that the necessary replacement yardage will approach 200 cu. yd. per mile over the entire system of sand-gravel and chat surfaced highways as an average annual maintenance item. This will necessitate an expenditure of $500 to $600 per mile per year for surface materials excluding the cost of surface or roadbed maintenance.

Cost of Surface Maintenance.—Our records indicate that the cost of surface maintenance alone ranges from $250 to $300 per mile, and this does not include roadbed maintenance, structures, or right-of-way. These latter items are necessary on all types of highways, and are, therefore, not considered in the comparison of costs. A combination of the surface maintenance items including the material replacement will show a cost ranging from $750 per mile to $900 per mile as an average annual expenditure on each mile of light type surfaced road under maintenance on the Kansas system. This great expenditure is rather alarming and can be attributed largely to the fact that light type surfaced roads are being constructed and maintained on highways were the traffic demands are greatly in excess of the capacity of this type of highway.

The Kansas situation in highway finances is such that no large initial expenditure can be made for paved highways. It is more important to expend the available funds for a large mileage of light surfaced roads than for a few miles of hard surfaced highways. The problems now confronting the Kansas Highway Commission with the light type surface roads are, first, the reduction of material replacement by bituminous or calcium chloride treatments, second, the elimination of dust with either of the above applications.

An attempt is to be made during the coming season toward applying some of these treatments and the results will be awaited with interest showing whether or not a reduction in maintenance costs can be accomplished and with an additional service from the highway. It seems that under a limited financial program that this stage improvement of roads now under maintenance will be the only solution to a better system of the highways. While the maintenance costs on the light surfaced roads appear to be very high, it is believed that the convenience to the traveler and the reduced operation cost of motor vehicles will offset any reasonable maintenance expenditures which improve the road for 365 days service.

Acknowledgment.—The foregoing is a paper presented Feb. 27 at the Southwest Road Show and Show.

Table I—Resurfacing Work by State Highway Commission in 1929

Division No.	Miles Sand-Gravel Maintained—1928	Miles Sand-Gravel Replacement Constructed 1929	Total Replacement Cost	Actual Replacement Cost per Mile	Actual Cu. Yds. Replacement per mile	Cu. Yd. Mile Av. per Tot. Mile	Cost per Mile Over Total Mileage
1	427.7	237.6	$219,996.30	$ 925.91	315	160	$514.37
2	341.5	100.8	124,797.44	1,238.07	465	140	365.44
3	402.0	108.1	50,144 00	463.86	215	60	124.73
4	580.0	145.0	148,066.57	1,021.14	400	100	255.28
5	350.0	45.0	26 910.50	598.01	285	40	76.90
6	223.7	86.2	53,969.10	629.09	210	80	241.25
Totals and Averages	2,324.7	722.7	$633,883.91	$ 876.96	320	95	$272.67

Standards for Future High-Ways in Germany

For the purpose of gradually improving the German principal highways, the Ministry of Traffic plans to fix certain standards for future constructions and repairs. The proposal is only under discussion and has not yet been presented to the Reichstag for approval. Edward A. Dow, U. S. Consul at Frankfort-on-Main, reports on the plan as follows:

The width of highways is to be at least 19.6 ft. for ordinary two-track highways. For triple widths (with a central width for passing other cars) the minimum width should be 27.9 ft., and for four paths, 36 ft. The width of 9.8 ft. for each path in a two-track highway is considered the minimum. Whenever possible, the width of the one, two and three-track highway is to be 22.9 ft., 29.5 ft. and 39.3 ft. respectively. Facilities are also to be afforded for bicyclists, who are very numerous in Germany. These latter are to be forbidden the use of the automobile part of the highway.

The suggestions provide trees at both sides of the highway. This suggestion does not meet with approval on the side of motorists, who claim that trees are a constant menace to a car which may accidentally leave its track, and propose as a substitute hedges of about 3.9 ft. height.

Further details of the standard suggestions are that level crossings should be eliminated, that the highway should be given its full width on bridges as well as in underground crossings, and that parking space, tanking wells, etc., must not obtrude on the highway.

Gravel Road Maintenance in Nebraska

How the Sand Gravel Roads Are Constructed and Maintained by Constant and Intelligent Blading and Dragging

By A. C. TILLEY

Maintenance Engineer, State Bureau of Roads and Bridges, Lincoln, Neb.

IN Nebraska, we have 4,600 miles of gravel surfaced highways, 4,000 miles of which have been constructed during the past 4½ years. We adopted this lower type of surface in the beginning, not entirely because of confidence in the adequacy of a gravel surface for our average traffic condition, but rather because we were forced to accept this type due to our finances which did not permit of the construction of the necessary mileage of a higher type surface. The results were more favorable than expected; in fact we had built much better than we had thought. At the outset, we did not consider this type adequate and economical for traffic above 1,000 vehicles per day, yet with increased traffic we now consider a gravel surface as being quite suitable to a traffic up to as high as 1,500 to 2,000 vehicles per day where soil conditions are favorable and maintenance gravel is readily available.

Fine Material Used.—The material which we have used is much finer than that which is ordinarily used for surfacing. Our specifications provide that 70 per cent of the aggregate shall be retained on a No. 10 sieve and 0 per cent to 50 per cent on a No. 4 sieve, and that 100 per cent shall pass the 1 in. sieve. This gives us a material which is often called sand gravel. However, we adopted this specification originally because it fit most closely the available supply of gravel in our state, yet as stated before, we have obtained better results than were expected, and instead of lamenting our lack of coarse material, our results have been such as to cause us to favor this material over the coarser gravel. In fact, in order to use material from local dry deposits, we have at times made a special specification to permit the use of material of which only 3 per cent is retained on a No. 10 screen.

We learned too, with the average conditions that prevail in Nebraska, that comparatively thin layers of sand gravel, varying from 2 in. to 3 in. in thickness over 21 ft. width, provided a satisfactory surface with the least total cost.

Our most dependable supply of gravel is the Platte River which furnishes us with well over 50 per cent of the material used. This means that we have to ship a very considerable part of our gravel, in fact approximately 70 per cent comes from commercial plants located on railroads, which means that for both construction and maintenance gravel, we pay freight on about 70 per cent of the total quantity of gravel used. However, as an average, we have been able to keep our total cost down to approximately $2,500 per mile for 3 in. thickness and a proportionate cost per mile for amounts less than 3 in. This average includes a range from $1,000 per mile to $4,000 per mile.

Typical Gravel Road in Nebraska—Highway No. 8, West of Meadow Grove

Method of Construction.—Once the grading is completed and compacted and the structures are built, the construction of the gravel surface is comparatively simple. The gravel is simply dumped along the outer edge of the roadway, this really completing the construction operation. The road is then turned over to the maintenance forces who spread a thin layer of gravel over the roadway and windrow the surplus along the shoulder of the road, to be later spread as fast as the soil is able to absorb it.

The road is then ready for routine maintenance. As stated before, the construction is quite simple, but the success of a gravel road depends largely on the maintenance.

Patrol Sections.—We have divided the entire system into patrol sections. The length of each section varies, with the average length about fourteen miles. A patrolman with proper equipment is assigned to each patrol. At present on our 6,500 mile system we have about 455 patrols; on 380 we are operating either one man pushtype motor graders or tractors with pulltype blades and drags; on 40 we are using trucks with drags and pulltype graders; and on 35 we have team patrols. After some experiment, we have decided this year to go more into the use of trucks with blades underneath, the reason for this being not that we consider the trucks more adaptable

Use of Blade and Drag in One Operation

View of U. S. 26, Showing Winter Maintenance

generally for gravel road maintenance, but rather that we might have equipment suitable for use in snow removal and for hauling purposes.

We consider it very essential that each patrol be equipped with a blade as well as a drag, as we have found that the use of a drag alone tends to cause a wavy road surface in time and that corrugations are more apt to form. Except when the road is too wet and heavy, our patrolmen use both the blade and drag, setting the drag so that it picks up the loose material that comes off the end of the blade and redistributes it uniformly over the portion of the road smoother by the blade.

Roads Bladed Are Dragged.—It is considered very important that gravel roads be bladed and dragged constantly, the idea being not to smooth them but rather never to let them get rough. To this end our patrols on main highways are bladed every day, and on light traffic roads at least every other day, in both winter and summer. Particular attention is given to thorough blading during and immediately following rains. Proper attention is given to maintaining a good crown and the road is bladed either in or out or entirely across as the occasion demands. At intervals the surface is bladed against the traffic as a means of keeping down corrugations.

Duties of Patrolmen.—To insure uniform maintenance on all sections, patrolmen have certain definite duties to perform. Each patrolman is expected to give first consideration to the surface of his road. He is expected to keep one shoulder clean to provide drainage and to keep a straight windrow on the other shoulder with drainways at the low points. He must keep all signs in constant repair; keep the weeds cut at culverts and bridges; and keep in mind always the necessity of protecting the public from hazards that may arise. Many of the patrolmen also have time for other rountine duties but where they do not, extra labor is provided. Chief patrolmen who have charge of about ten patrols, make frequent inspections to see that patrolmen are carrying out the duties assigned them and they provide extra help where the occasion demands it.

The cleaning of ditches and realignment and reshaping of shoulders, the moving, the repair of structures, etc., are accomplished by extra crews properly equipped for this work.

Snow Removal.—In Nebraska we attempt to keep the snow removed from our entire system. On our gravel roads we feel that it is very important to blade the snow entirely off the surface to prevent it from melting and so saturating the gravel mat as to cause it to rut. At present we have erected approximately 800 miles of slat snow fence which we have found to be very satisfactory. In snow periods our patrolmen start out while it is still snowing and remove all that they can with the regular maintenance units. They are able to handle up to 4 or 5 in. of snow quite well. The drifts are removed by trucks or caterpillars with snow plows or blade graders. These machines work night and day until the roads are open.

Costs.—Because the cost of maintenance varies, due to traffic, soil, topography, and the elements, it is apparent that the cost per mile varies greatly in different parts of the state and on different patrols. As an instance of this, our maximum cost in 1928 was on Highway No. 75 south of Nebraska City, and amounted to $1,395.95 per mile. On the other hand in the Central part of the state near Sargent we had a cost as low as $222.72 per mile.

The average cost of maintenance of gravel highways for the entire state in 1928 was $380.88 per mile. This includes all items of maintenance, including gravel replacements. The 1929 costs are not yet available.

Conclusion Regarding Gravel Roads.—From our experience with gravel

A Gravel Surface on a Nebraska Highway

roads and from investigations that we have conducted, we have drawn the following conclusions:

That like any higher type surfacing, the success and serviceability of a gravel surface is greatest when placed on a well graded road.

That the subgrade material on which the gravel is placed also plays a very important part in the life and maintenance of the road. This is particularly true where clean or washed gravel is windrowed and spread for traffic to compact, for the binder must come largely from the subsoil material.

That proper drainage is very necessary to prevent rutting and disintegration during wet weather, and to prevent frost boils in the spring.

That ability to maintain the road surface free from corrugations depends largely on the quality of the subsoil and that light soil in a dry country is particularly conducive to corrugations.

That gravel having a uniform grading produces a smoother road surface and is easier to maintain.

That a sand gravel road is distinctly different from the class of roads usually referred to as gravel roads or from the class referred to as sand-clay roads.

That on soils adapted to it, the sand gravel road is preferable to either the gravel or sand-clay road in that it is free from slipperiness, partakes of the smoothness of a sand-clay road, does not ravel like a gravel road, and has good wearing and carrying capacity.

That dry weather blading and draggings is very beneficial and should be practiced except possibly on roads having unusually light subsoil and in a windy section.

That the adapability of the patrolman—his intuition for doing the right thing at the right time—has much to do with the kind of maintenance obtained.

But last and most important is this conclusion, that without regard for all of the basic factors which tend to make for a good or a poor road, one fact remains, namely: that the best riding surface possible on any gravel road can be obtained only by constant and intelligent blading and dragging.

Acknowledgment.—The foregoing paper was presented Feb. 27 at the 5th annual Southwest Road Show and School.

1930 Road Program for Edmonton, Alberta.—The Province of Alberta, Canada, has announced a 1930 road program totalling $5,550,000. The main items are as follows: Main highways construction, $2,000,000; main highway maintenance, $960,000; district highways construction, $750,000; district and city road maintenance, $500,000; secondary highways construction, $150,000; new bridges, $750,000; maintenance bridges, $60,000; ferries, $80,000.

States to Spend More for Highways in 1930

Cooperating with President Hoover in his plea to enlarge all construction programs as much as is practicable to ameliorate the unemployment situation, the states and their counties will spend in their road building programs for 1930 at least $250,000,000 more than they spent in 1929.

Reports received from state highway departments and compiled by the Bureau of Public Roads, U. S. Department of Agriculture, show that state and local authorities plan to spend $1,601,167,455 for highway improvement in 1930.

The planned expenditure by state highway departments for construction and maintenance of state highways is $937,500,455; the balance, $663,667,000, will be spent, according to the estimates, on local roads and bridges. The state highway officials of 45 states estimate the total length of roads to be improved by them in 1930 as 32,532 miles, an increase of 3,126 miles over the estimate in the 1929 programs. Three states failed to report contemplated mileages for 1930.

The highway departments of all states will control the maintenance of 281,393 miles of highways this year, an increase of 32,381 over the mileage under state maintenance in 1929. Gradually, the states are taking over into their systems for maintenance the more important county and local roads of the country.

The states of greatest population and industrialization in which unemployment, naturally, is greatest, show the highest contemplated expenditures. The Middle Atlantic States, comprising New York, New Jersey, and Pennsylvania, plan to spend $374,835,310 on improvement of state and local roads; the East North Central States of Ohio, Indiana, Illinois, Michigan, and Wisconsin plan to spend $303,696,000.

The West North Central States, including Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, and Kansas rank third in their contemplated expenditure of $236,461,727, and the South Atlantic States of Delaware, Maryland, Virginia, West Virginia, North Carolina, South Carolina, Georgia, and Florida, with an expenditure of $182,872,418, rank fourth; the West South Central States of Arkansas, Louisiana, Oklahoma, and Texas rank fifth with $154,100,000.

Statistical Story of U. S. Highways in Booklet

A statistical story of the growth of highway systems in the United States and in the world is recited in Highways Handbook, a recent illustrated publication by the Highway Education Board.

Data and information used in the booklet are from government tabulations, the United States Bureau of Public Roads and the automotive division of the Bureau of Foreign and Domestic Commerce being the principal sources of supply. The 97 pages of the handbook, the first comprehensive grouping of highway statistics into one volume, are divided into ten chapters, each treating of a separate phase of the subject.

One chapter is devoted to a general summary, an itemization of interesting features in connection with the subject. What is the longest paved road in the world; what state has the largest highway mileage; what is the shortest road and the most narrow street; what is the proportion of United States highways to the rest of the world? These and a hundred other pertinent questions are answered in the section on "milestones."

Tables giving total road mileage, road income, and expenditure, and other related data, by years, by types, by states and by counties appear frequently in the booklet.

In the table on total mileage and total mileage surfaced, it is disclosed that of the 3,016,281 miles of rural roads in the United States, 69 per cent is under the supervision of local authorities, or those other than state and Federal officials.

A chapter on Federal Aid operations, falls second in the booklet, while separate chapters are allotted to the state highway systems, and to county and local activities.

World highway mileages afford a vivid comparison of the growth of automotive transportation in the United States, statistics for 137 nations and autonomous countries being presented.

A chapter on highway uses offers an interesting study, while another on uniform warning and direction signs, portrayed in colors, gives the signs recommended for use by the American Association of State Highway Officials.

Chapters on highway films available, on bibliography, and finally on organizations interested in highway development complete the study, with an explanatory note outlining briefly the activities of the Highway Education Board.

Improvements in Asphalt Paving Plant Equipment and Methods

Improvements and Changes in Methods at Municipal Asphalt Plant, Flint, Mich., During Past Season That Have Demonstrated Their Worth

By H. C. McCLURE
City Engineer, Flint, Mich.

THE plant consists of two Warren, internally-heated, 25-ton dryers, with a 2,000-lb. mixer. The dryers are oil-fired and the plant steam is furnished by a 125-hp. coal-burning boiler, furnishing steam at 140 lb. pressure. The maximum month of over 95,000, and a daily average of over 3,600 sq. yd. of 3-in. top during August indicates the possibilities of this plant.

Dust Collectors.—The question of dust elimination was serious, the plant site having been closely built around the past few years. An air-washing system, taking dryer, elevator and stack discharges, was operated quite successfully for several years, but the dust (8 to 10 tons daily) was wasted. The past year the American Blower Co.'s dust collectors, of the latest industrial type, were installed.

These collectors reverse the old dust collection idea. Instead of slowing up the velocity of the dust-laden air, so that particles can settle out by gravity, they speed up the air a great deal and actually give the minute individual particles enough velocity to throw them to the outside of the dust collector circle. The air discharge is then taken off the center, where very little dust remains. By actual tests the collectors will get better than 99 per cent of the 200 mesh and finer particles, in less than 20 seconds after it is picked up. The remaining fractional per cent of extremely fine dust is taken into the oil air washer stack and washed down.

The collector fans are connected to the dryer discharge, elevator, mixer and other points, where fine dust particles usually escape. The collectors automatically and continuously discharge directly into the sand elevator, just ahead of the mixer. This process places the dust back into the heated sand mixture, in just the same proportions as it enters at the cold end of the dryer, and gives almost identically the same hot sand grading as existed in the stock pile.

An average of 80 lb. of dust per minute is reclaimed. This is equivalent to over 20 tons per day on our present year's run, which, at over $5 per ton, not including handling, represents a saving of over $100 per day when top is being run. The dust from the binderstone is handled in the same manner, although no saving is figured on binder dust. Plans are now being made to add all dust next year at the cold end of the dryer and produce an all-hot, dry-mixed aggregate.

Aside from the direct savings in dust cost, and the elimination of the neighborhood dust nuisance, the reclaimed dust goes back at over 225 deg. temperature, showing a decided reduction in fuel consumption. Our oil consumption, during the past year, has been less than 0.35 gal. per square yard; and our boiler plant burns 1⅓ tons of coal per 1,000 yd. of top. A stoker installation for this winter will reduce this coal consumption to a still lower figure.

By delivering to the mixer a sand very nearly identical with the stock pile analysis, our chemist is able to accurately proportion his mix from stock pile samples. This is not the case in the ordinary plant, where most of the 200 and even 100 mesh sizes are lost in heating. Some experiments have been made on using a fine pit run silica dust through one dryer and regular sand through the other with fine results.

Heat Control.—The collector fans are driven by variable speed motors. Instead of constantly changing the rate of feeding or heating, to control sand and stone temperatures, the operator merely changes the fan control a point or two either way, giving more or less draft, and has obtained far more uniform material temperatures than ever before. The material feeding and oil firing now often run during an entire day at practically a uniform rate.

Automatic thermostatic control of the fan speed from the elevator temperatures is now being worked out and it looks like this will be entirely possible.

Asphalt Storage.—With somewhat limited track facilities and a demand of more than 15 cars of material daily at the asphalt plant alone—to say nothing of the many additional cars of other yard and construction materials—it can be realized that shipment delays would be costly and highly desirable to eliminate, the greatest chance for serious delay being in the asphalt.

To eliminate this, a 60,000-gal. storage tank was installed. That this installation has been justified from the standpoint of elimination of delays only, we need only to mention that the plant has not been shut down a single hour because of a lack of asphalt, since the tanks were connected up.

Accumulated shipments, due to faulty railroad deliveries, are also promptly unloaded, releasing track space and eliminating demurrage. The quantity in the storage tank has been varied from less than one hour's supply on one occasion to over 50,000 gal. at several other times.

The tank is equipped with general low temperature heating coils, and a triple nest of center (hot spot) coils for heating AC to mixing temperatures. Those "hot spot" coils quickly heat and keep the center of the mass at about 300 degrees, and the balance of the contents so that it will flow slowly toward the center area. It is possible to close the plant down on Saturday P. M., start steam again about 4 o'clock Monday morning, and have the plant in full operation before 6 o'clock.

Pumping.—A single steam engine driven pump unloads cars and also supplies A. C. to the plant. Pump supply connections are made to car unloading lines and to the discharge line from the storage tank as well. Pump discharge lines run to the storage tank and to the plant. The pump discharge line to the tank is fitted with a spring pressure valve, and the plant line with a quick cutoff valve at the mixer.

Asphalt is all shipped in insulated tank cars. It arrives at a temperature of from 150 to over 200 degrees, depending on the length of time on the road. A half hour, to not more than two hours, plant steaming is required before pumping is possible. Sundays or nights the cars are pumped directly into the storage, allowing prompt release of cars. During working hours, the cars are emptied to both storage and plant at the same time, as follows:

The governor has been removed from the engine. When the cutoff valve at the mixer is open, the drop in pressure allows the engine to instantly speed up and quickly supply the desired quantity of A. C. When the valve is closed, the pressure in the lines at once builds up enough to open the spring valve on the tank line and, between boxes, the pump is discharging into the supply tank. The same procedure is followed when pumping from storage, except that the surplus between boxes is pumped back into storage, or, in a measure, recir-

culated. The cost of 50 ct. per ton, for the use of insulated tank cars, has been saved in plant time and elimination of demurrage.

Heating. — As stated above, all asphalt is received in insulated tank cars, which permits short plant steaming periods before pumping. The supply line to the mixer—approximately 100 ft. long—is double steam jacketed. Instead of having the usual outside steam jacket only, an additional steam line is run through the center of the asphalt line, as well. The comparatively thin cylinder of asphalt around and inside those high-pressure steam lines, is delivered from the cars directly to the mixer, around 300 degrees, and the supply from the tank easily kept at this temperature. Many cars have been used directly from track to plant with no delays in car release.

Mixer.—The mixer liners of a different composition than formerly used, allowed the plant to turn out over 300,000 sq. yd. of 3-in. top before any replacements were necessary. This is much better than we have been able to do in past seasons. Replacements were made at this time, because of a plant shut down between jobs, and not because, at that moment, the mixers were actually worn through.

Laboratory.—Our laboratory is one of the best equipped highway laboratories in our section of the country. It is fully equipped with modern asphalt and general testing equipment. The addition of a Hubbard stability machine, and a 200,000 lb. compression machine, has made it possible for us to follow stability values closely.

The piece of equipment which has saved the most time, however, is a Toledo special purpose scale of 150 grams capacity, reading directly to 1/10th gram. Weights up to this capacity are almost instantly taken. With the Rotap shaker and this scale, a complete screen analysis can be made and accumulated weights read to 1/20th gram, in about the same time as an equally accurate single weight can be taken on the usual even balance scale.

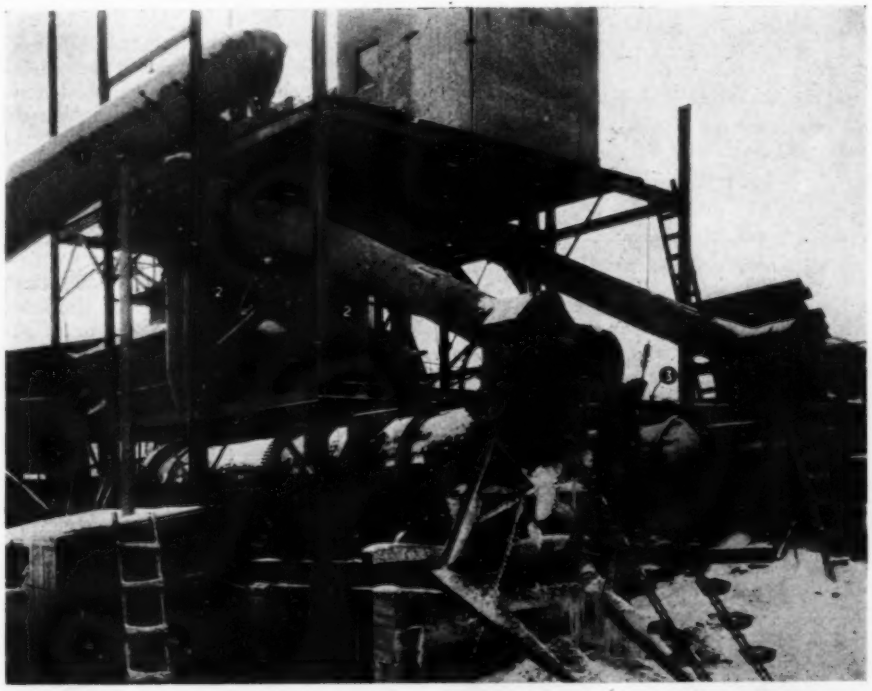
With the stability machine, our chemist has been able to make many more tests of sands and mixtures than would otherwise have been possible, and by this keep a very much closer check on plant production.

Street Samples.—Some very interesting experiments are being conducted, relative to the stabilities which are obtained, (1) by the prescribed laboratory method, (2) by applying 3,000-lb. pressure to identical samples, and, (3) the stabilities obtained on the street—under actual construction conditions. We have found a stability value of around 3,000 lb. obtained by the hand method of making up a mixture test sample, is increased to at least 4,500 lb. when placed in the compression machine with 3,000 lb. pressure. Samples taken by inserting short cylinders in the street before rolling, and later removed, show stabilities for these mixtures of around 2,000 lb. This street stability is obtained by the use of a 12-ton 3-wheel initial roller, followed by 10-ton tandems. The 12-ton 3-wheeler figures over 350 lb. per inch width of wheels, dead weight. This heavy roller forces a very uniform mix, as one a little fat will crowd, and a little stiff will crack during the rolling.

These experiments are being carried on further, and it is hoped that reports of some worthwhile results will be possible later. Steel rings made of 1½-in. sections of steel pipe, turned thin and smoothed on the inside, inserted at the time of rolling, are also being left in the pavement to be removed after several months or a year of traffic compression, in order to determine what change in stability occurs under actual traffic conditions. We have found that samples cored from the street show very misleading and varying stability values, due doubtless to the disturbance of the outside portion of the samples in cutting, and, that the steel ring method gives better results.

Plant Weighing.—Other improvements which were contemplated last year, but which, because of our inability to shut down the plant, have not yet been installed, include the installation of platform scales for measuring the asphalt. This scale, which has been purchased, is equipped with a very large direct reading dial which will at any instant record the amount of A. C. in the bucket. The bucket will be mounted on a frame fastened to the platform, and will be capable of being dumped over into the mixer in much the same manner as the asphalt bucket is handled at the present time. The amount of A. C. will always be read directly on the dial, as the weight of the bucket and mounting will be taken care of by a proper back-weight, and the varying amount of A. C. adhering to the bucket during a day's run will be adjusted at any moment by an auxiliary tare beam. We believe that this continuously indicating and direct reading scale will enable the operators to take care of the A. C. Quantities very much more quickly and very much more accurately than they can do with the beam type of equipment. A movable dial indicator is to be fastened to the scale, so that if the quantity of A. C. is varied at any time, the indicator can be easily clipped to the desired point by the chemist, leaving no item of guesswork at all in the hands of the workmen.

Finishing Machines.—With the improvements in the plant completed, in use and generally satisfactory, the street end of the job was next given attention. The heavier 3-wheeled rollers apparently are giving much better compression and pick out porous spots better than is possible with tandems or any other rollers of the usually smaller



View Showing Arrangement of Driers, Collectors, and Asphalt Line at Asphalt Plant of Flint, Mich.

The main exhaust pipe (1) from the two collectors, takes only the finest of material, which ordinarily would go into the air, almost as smoke dust, and carries it to a stack to which sprays are mounted to wash down this very finest material. This material would easily pass a 300 or 400 mesh sieve.

The two collectors (2), one for each drier, are located at the hot end of the mixers, and from the bottom of these collectors, screw conveyors carry the collected fine dust back to the elevator just ahead of the mixing boxes.

The asphalt supply line (3), carries the asphalt to the plant from either the tank storage or from the railroad tank cars, as the case might be. In either case, the double steam jacketing is sufficient and the approximate 100 ft. of travel to raise the A. C. to the desired temperature.

weight. The method of taking samples from the street for testing purposes, by means of inserting machined steel cylinders, is apparently going to work quite satisfactorily. The use of finishing machines to strike off the binder and top, has been undertaken just recently.

Our use with these machines does not cover a very large yardage, but from our limited experience with this equipment, we believe that it would be possible to work out from the existing machine, something which would be very satisfactory and will materially reduce the street labor costs. From our preliminary experience with the troubles of adjusting this new equipment to city street conditions, it appears that at least 8 or 10 men can be dispensed with on the usual ordinary job. The action of the machine, with a considerable quantity of material ahead of it, is about the same as that of a roller of several tons capacity, and the use of our 3-wheel 12-ton roller does not show the compacting action of more than a ¼ or ⅜ in. at the most. The rollers are able to keep pace with the job much more easily, and, on the most recent jobs completed, two rollers have been able to keep up—whereas three were used to keep up with the job before.

The use of the machine requires a plant of considerable capacity, not less than 5,000 or 6,000 yd. of 3-in. thickness. The machine also requires that the mixture be uniform in composition, and especially is it necessary to have the mixture uniformly hot. A load a little cool which might otherwise be satisfactorily handled by the shovelers and rakers, under ordinary methods, will tend to drag under the machine—so that in effect it gives an additional automatic check on the uniformity of the mix being handled.

We have found the surface produced by the use of the machine to be an extremely satisfactory riding surface. Studies are being made on the stability at each stage in the operation, with the use of the machine, as compared with the ordinary roller compression alone. We are making no definite plans on the machines until we find how the surface works under traffic.

Acknowledgment.—The foregoing is a paper presented at the 8th annual Asphalt Paving Conference.

Letters to the Editor

How to Prevent Speeding

To the Editor: Mr. Halbert P. Gillette "writes by the book" when he says in *Roads and Streets* that education has failed in our efforts to have people drive with discretion or even oridinary intelligence. It's human nature: put a machine that can travel 80 miles an hour into any man's hands and he's going to drive at that speed every chance he gets, when he feels safely out of the Ken of the Kops!

Think of it, in railroading we train locomotive drivers for years, examine them regularly for sight, judgment, liquor, everything. The roads are every scientific device to keep 'em there and to guard against accident, watchmen at gates, keen fellows dispatching, block systems and what not. Then we go and let flocks of young locomotives loose on our crowded thoroughfares, great cars driven by incompetents, youngsters, drunks, any one, and wonder that thousands of our people are killed and hundreds of thousands maimed every year."

I'd like to go Mr. Gillette one better: Make high speed cars for properly protected race tracks and speedways if you wish, but, have others intended for road and street use keyed down, sealed or otherwise rendered incapable of going more than the established rate. If you don't want fast driving you must make it so they can't drive fast. No half measures will do.

Some eight years ago I proposed this same thing and Lordy but you should have heard the yowl from the speedsters!

F. W. FITZPATRICK,
Consulting Architect.
Evanston, Ill.

Superelevating and Widening of Curves

To the Editor: I was interested by the article in your January issue of Roads and Streets describing the method of superelevating and widening of curves in the state of Vermont.

Oregon has been using this method, with one exception, for the past five years. This exception is the gradeline which the sketch shows as being carried on the centerline of roadbed. This, we have found, causes a dip in the roadbed and unless coming on a curve which is also on a vertical curve, is very noticeable and if coming in a cut you have an extra drainage problem to face. For instance, useing a 20 ft. roadbed and with 3 ft. extra widening you have 13 ft. of pavement inside of centerline. Using 1 in. of superelevation per foot the inside edge of pavement is 13 in. below grade.

Oregon has eliminated this by carrying the inside edge of the pavement at grade and obtaining the superelevation required by raising the outside edge the full amount of superelevation above grade line.

J. L. GILLIS,
State Highway Department.
Tillamook, Ore.

Accident Prevention on Construction

Strenuous efforts are to be made to insure that the 1930 construction program is carried on under conditions which will prevent accidents, according to Major W. R. Richards, secretary of the Associated General Contractors of America and head of the accident prevention work conducted by that organization. With the example of more than a thousand general contractors applying accident prevention methods on their jobs during 1929 and securing reductions in accident frequency and severity ranging from 10 to 80 per cent, it is proposed to launch a nation-wide program to extend safety promotional activities to the actual jobs on which accidents occur.

Ways and means to organize every construction project for accident prevention in 1930 was one of the leading items on the program of the recent convention of the Associated General Contractors of America at New Orleans. The old theory that accidents on construction work are inevitable because of the hazardous nature of the operations has been amply refuted, claims Major Richards. In a partial preliminary checkup of the records of contractors who have carried on accident prevention work on their jobs during the year a total of nine construction firms have already been found to have passed through the entire year without a single lost time accident. Many other similar records are expected to be uncovered as the work of tabulating and checking the safety records proceeds. The nine firms with unblemished records were found in an examination of the experience of the first 80 firms on the list of more than a thousand whose records are available.

The Associated General Contractors of America conducts an annual contest among its members to determine which individual member firm has the best record, which local chapter has the fewest accidents and which member of all the local chapters has the best showing. The competition is for national championship cups. They are awarded in the case of several perfect scores to the contestants having worked the largest number hours.

Since contractors with good safety records ordinarily secure compensation insurance at lower rates it has been shown to be immediately profitable as well as humanitarian to put construction jobs on an accident prevention basis.

Philippine Highway Work.—During 1929 there were 292 active road construction projects, with a total appropriation of $3,211,000; also 7,394 miles of road maintained at an expenditure of about $3,250,000. For 1930 approximately $7,500,000 will be available for construction and maintenance of roads.

ROADS and STREETS

Published Monthly by
GILLETTE PUBLISHING COMPANY, 221 EAST 20TH ST., CHICAGO

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New York Office.....420 Lexington Ave.
San Francisco Office.....703 Market St.
Subscription Price $2.00 Foreign Postage 65c Extra

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A Cure for Our Worst Economic Disease

Economic analyses made by the editor disclose that American per capita productivity is fivefold what it was a century ago. The buying power of the average wages has increased at the same rate as per capita productivity. Not only does this latter fact prove that socialists have been wrong in forecasting dire results from a continuation of the capitalistic system, but that labor unionists have been equally mistaken in their predictions that "the machine age" would enslave the worker and reduce his income.

By socialists and labor unionists alike one important fact has been overlooked. They failed to see that competition among employers would result in average "real wages" rising as fast as the average productivity of workers increased. Yet the U. S. census since 1859 has shown that manufacturing wages have been an almost constant percentage of the wholesale value of manufactured products. The same holds true as to the cost of raw materials used in manufacturing. The clear inference from these two facts is that profits have been almost a constant percentage of the value of manufactured goods.

Recently there has been a loud renewal of the century-old cry of fear that machinery is destined to deprive most workmen of jobs. The "robot" is pictured as a mechanical man who all but thinks; so it is prophesied that even the most skilled of workmen are doomed to be displaced by machinery. While it is true that ever since men entered "the machine age," about 150 years ago, machinery has displaced workmen here and there, it is equally true that machinery has coincidentally broadened the market for goods and has given to the average American an income sufficiently great to enable Americans to buy the increased output. Although this is usually admitted even by the pessimists, they are now arguing that the end of such an adjustment of production and income is in sight. Here again they fail to see that human desires are insatiable, and that so long as any desires remain unsatisfied production will continue to increase.

The great economic problem that lies before business men is to distinguish between those goods and services for which the demand is limited and those for which it is either unlimited or at least very flexible. Four pounds of food daily is all that the average human stomach can digest. Hence, so far as quantity of food is concerned, the demand for food in America can not increase faster than the population, or at the rate of about 1.5 per cent annually. On the other hand, there is an almost limitless demand for more expensive household furniture. We venture to say that few men or women go through the Huntington Art Gallery at San Marino, Calif., and view the magnificent tapestries, rugs, paintings and furniture, without wishing that they were the owners of at least some of it. In that wish lies the latent demand for better household furniture. By advertising and by "furniture shows" this latent demand is being slowly fanned into a great actual demand. No one can say what the result will be eventually, except that it will lead to the spending annually of many times as many dollars per capita for furniture as are now spent. It will require men and machines to make the furniture, and more men and machines to make the machines that make the furniture, and many men to sell both machines and furniture.

There is a limitless demand for amusement, as three industries have proved to the limit, namely, the motor car, the radio and the moving picture industries.

Even yet the motor car is primarily a pleasure giving device. Follow for a moment the result of its evolution. When the gasoline car began to appear frequently on our roads and streets in 1895, who would have dreamed that practically every American family would own one within 35 years? Even now how many of us seriously expect that the average American family will own two motor cars within the next 20 years?

A by-product of the motor car industry has been another industry in which more than two billion dollars are annually expended, namely, the great highway industry. Still another great by-product industry is the one devoted to the production and distribution of gasoline. Had it not been for the motor car, the building and maintenance of highways in America would still be a relatively small industry.

If more business men will learn to avoid trying to expand productivity in fields where latent demand is limited and where the production facilities are already more than adequate, and will direct their attention to fields where latent demand is great, we shall hear less and less of overproduction and the ills of the machine age.

Does "Space" Offer Resistance?

When ether was first conceived as a medium for transmitting light waves, it was endowed with most of the properties of ordinary matter, yet it was supposed to offer no resistance to the passage of bodies through it. So it was denied the possession of the most important property of matter, namely mass. This incongruity, while seemingly imaginable, has always been one of the greatest objections to the theory of a "luminiferous (light-carrying) ether." On the other hand, that theory has been so amazingly fruitful in discoveries as to the nature of radiant forces that it would be even more amazing were it not essentially a sound theory. Let the mathematicians say what they may about "convenient fictions," such as an ether,

common sense rejects the idea that truth repeatedly emerges from fiction. Furthermore, there is this principle of research logic to be considered: The ultimate test of the truth of any hypothesis is that inferences drawn by its use agree with facts to such an extent as to make the hypothesis highly probable. If, therefore, since the ether hypothesis has been used to derive many quantitative laws about radiant energy that agree with observed facts, that hypothesis has received the severest of tests and has emerged victorious. What other hypothesis in the whole realm of science can show better proof of its truth?

No one has secured direct evidence of the existence of ether, if by direct evidence is meant either visibility of its substance or direct measurement of its resistance. As to lack of visibility, that may be dismissed as an objection of no consequence, for we are certain that molecules, atoms and electrons exist, although they are all invisible. We are certain that they exist merely because hypotheses based on their assumed existence lead to inferences that agree quantitatively with many observed facts. Moreover there is abundant evidence that they have mass, in which respect they apparently differ from ether. Also let us not forget that barely more than a decade ago, physicists were astonished when Einstein stated that rays of light have mass and gravitate. That he was right is now generally conceded, because astronomers have measured the deflection of light rays from stars when those rays pass near the sun on their journey to the earth.

By the same Einstein theory that makes mass and energy identical in nature, it is inferred that all radiant waves have mass. If so, does it not follow that space is literally full of masses? We did not require Millikan's discovery of cosmic rays to assure us that space must contain radiations moving in all directions. The radiations from stars must of necessity form a network of energy threads. So when any celestial body moves through this network of radiant rays it must encounter resistance, for those rays possess energy, therefore mass, therefore inertial resistance.

Long before Einstein's relativity theory was announced, physicists had proved that a light wave impinging upon a surface exerts pressure, so it was inferrable that such a wave has mass; yet, curiously enough, physicists hesitated to believe that ether has mass, even when they regarded light as being merely an ethereal wave. Note well the incongruity of admitting that light exerts pressure, while asserting that ether lacks mass. This incongruity arose primarily from the belief that if ether were assumed to have mass, then the planets would be approaching closer to the sun every orbital revolution, because of ethereal friction, evidence of which approach was lacking. As a matter of fact, who dares say that planets will not eventually spiral into the sun? As the sun loses rotative velocity, the planets tend to recede from it; but when the sun's rotative velocity is sufficiently reduced, they must approach the sun as a result of encountered resistance, even if it be no other resistance than that of Millikan's cosmic rays. This seems an inescapable inference. Encke's comet has drawn closer to the sun since its discovery, but this is commonly supposed to be due solely to the resistance of meteorites and the like. Undoubtedly this partially explains the spiral path of that comet toward the sun, but it may also be appreciably resisted by the ether and it certainly is resisted by the network of radiant waves that it encounters.

All matter is either radiating or absorbing energy, and therefore is losing or gaining mass. If the radiations from the rear face of a moving body exceed in energy those from its front face, the body is propelled forward like a skyrocket. The writer has advanced this hypothesis of self-propulsion to account for several phenomena. Among these phenomena are: (1) Inertia; (2) gravitation; (3) flattening of the electron as its velocity increases; and (4) approximate maintenance of the orbital velocity of planets in the face of ethereal resistance.

Faraday conceived lines and tubes of electrical force, emerging from charged bodies. Heaviside proved that the tubes of electrical force that emerge from an electron are uniformly radial when it is at rest, but gradually shift their direction as the velocity of the electron increases, so that if the electron were to attain the velocity of light the tubes would all be in a plane perpendicular to the electron's direction of motion. No physical explanation of this shifting was suggested by Heaviside; nor does Einstein suggest an explanation, although his relativity theory leads also to Heaviside's formula. But if a natural ether exists, a shifting of the Faraday tubes is exactly what would occur, for the ethereal resistance would force them to bend backward. Then if the electron were being propelled by an excess of radiations escaping from its rear face, their reactive push would not only propel the electron but would cause the Faraday tubes to bend upward. Hence between the resistance of the ether in front and the reactive push of radiations (=particles of ether?) escaping from the rear of the electron, the Faraday tubes would assume just the position that the Heaviside formula assigns to them.

Are the Faraday tubes non-existent? Are they merely "a convenient fiction"? Sir J. J. Thomson ("Electricity and Matter," p. 9) says: "To Faraday the lines of (electrical) force were far more than mathematical abstractions—they were physical realities. Faraday materialized the lines of force and endowed them with physical properties so as to explain the phenomena of the electric field." Faraday was not a mathematician, but Sir J. J. Thomson is among the greatest of mathematical physicists, and by adopting Faraday's hypothesis he converted it into a theory as well established as any electrical theory. Moreover, he also believes in the physical reality of the Faraday lines of force and tubes. About 30 years ago he showed that the Faraday tubes have mass.

So many facts point toward the existence of an ether possessed of mass that the writer has never doubted its existence even when such an eminent physicist as Einstein has expressed his doubts. Einstein substitutes "fields of force" for Faraday's material lines of force"; and Einstein provides "waves" in his "fields." But a "wave" where nothing exists to wave is beyond the imagination of anyone; so that while Einstein thinks that he has abandoned the conception of an ether, it would appear that he has merely rechristened the ether.

H. P. Gillette

Reviews of Recent Books

"Public Budgeting," by A. E. Buck, National Institute of Public Administration. First edition, 612 pages, 6 in. by 9¼ in., cloth hard binding. Harper & Brothers, New York City, N. Y., publishers. Price, $6.00.

This volume is a wordy discourse on existing budgetary practices which have been evaluated by the author and from which he has attempted to point out the trend of development. The subject has been divided up under the following chapter headings under four main parts:

Part I. The General Aspects of Public Budgeting

I.—The Significance of Public Budgeting.
II.—Development of the Budget System.
III.—Legal Basis of Budgetary Practice.

Part II. The Budgetary Forms and Information

IV.—The Budget Document.
V.—The Budget Bills.
VI.—Nature and Sources of Budgetary Information.
VII.—Classification of Expenditures and Income.
VIII.—The Budget Estimate Forms.

Part III. The Budget Making Procedure

IX.—The Budget Making Authority and Its Staff Agency.
X.—Preparation of the Budget Estimates.
XI.—Review and Revision of the Budget Estimates.
XII.—Framing the Budget Document.
XIII.—Legislative Consideration and Action on the Budget.

Part IV. The Execution of the Budget

XIV.—Organization for Executing the Budget.
XV.—Maintaining the Budgetary Balance.
XVI.—The Budget in Operation.
XVII.—The Independent Audit.

"Proceedings of the Thirty-second Annual Meeting, A. S. T. M.," 1937 pages, 6 in. by 9 in., American Society of Testing Materials, Philadelphia, Pa., publishers. Price, each part $6.00, in paper binding.

Part I (921 pages) contains the annual reports of 43 standing and research committees and five sectional and joint committees of the society. They include reports of committees on ferrous metals and alloys, effect of tin and arsenic on high-speed tool steel, boiler feed water studies, non-ferrous metals, cement, ceramics, concrete, fire tests of materials, gypsum, lime, preservative coatings, petroleum products, road materials, coal and coke, waterproofing materials, electrical insulating materials, rubber products, textile materials, wire cloth, slate, natural building stones, methods of testing, metallography and nomenclature and definitions; 49 tentative standards which have either been revised or are published for the first time; annual address of the president and the annual report of the executive committee.

Part II (1,016 pages) contains 56 technical papers with discussion. These contain the symposium on physical properties of cast iron, the symposium on mineral aggregates, and valuable information on results of investigations by experts in the field of engineering materials, including research problems involved in cohesion and atomic structure, the fatigue of metals and corrosion-fatigue of metals. A number of particularly interesting papers on non-ferrous metals are included. Many other papers included are on cement, concrete and brick, and on bituminous mixtures, rubber and a number of papers of interest in connection with the testing of materials describing new testing apparatus.

"Timber Design and Construction," by Henry S. Jacoby, Professor of Bridge Engineering, Emeritus, Cornell University, and Roland P. Davis, Professor of Structural and Hydraulic Engineering, West Virginia University. Second edition, 334 pages, 6 in. by 9 in., cloth hard binding. John Wiley & Sons, Inc., New York City, publishers. Price, $4.50.

As the title clearly indicates, this volume deals with the design and construction of of timber work.

Chapter I contains the digested results of experimental investigations on fastening used in framing.

Chapter II is a discussion of joints in framing.

Chapter III is devoted to wooden beams and columns.

Chapter IV, on wooden roof trusses, contains the design of a bay of a building, including rafters, purlins and truss.

Chapter V shows examples of various types of timber construction.

Chapter VI covers the subjects of commercial grading, tests of clear timber, tests of commercial timber, factors influencing strength of timber, and unit stresses.

The book is profusely illustrated, which policy is commendatory in a volume of this type.

"Basic Principles of Concrete Making," by Franklin R. McMillan, Director of Research, Portland Cement Association. First edition, 99 pages, 6 in. by 9 in.; cloth hard binding. McGraw-Hill Book Co., Inc., New York City, publishers. Price, $2.00.

A habit is the hardest thing in the world to break. Concrete workmen and foremen have been drilled, in the past, into the habit of mixing concrete by proportions established arbitrarily before the plans were completed. As the knowledge of the nature of the composition called "concrete" was extended, the less well informed worker was not educated with the newer information. The result is that now concrete is still mixed according to some predetermined proportion on most ordinary jobs.

This book is a compilation of research results obtained by investigation of concrete mixtures. It is not written for the benefit of the concrete worker or foreman, but for the executive and engineer. It is presumed that the engineer can write his instructions to govern the job once he has acquainted himself with the newer theories and research results.

"The Public Works Department in American Cities," by Clarence E. Ridley, National Institute of Public Administration. 51 pages, 6½ in. by 10 in., paper covered binding. Municipal Administration Service, New York City, publsher. Price, 35 cents.

This is a discussion of public management in the department of public works. The organization of this department in twenty-five cities is given. From this collection and study of same he has evolved certain principles which are discussed in this booklet.

One excellent chart contained in the booklet shows how the typical division of technical qualifications for the administrative head of a public works department varies with the size of the city.

"Elements of Topographic Drawing," by Roscoe C. Sloane, Professor of Highway Engineering, Ohio State University, and John M. Montz, Assistant Professor of Civil Engineering, Ohio State University. First edition, 188 pages, 9 in. by 6 in.; hard cloth binding. McGraw-Hill Book Co., Inc., New York City, publishers. Price, $2.75.

This book is a compilation of standard symbols used in topographical drawing with written text and instructions as to how they are used. It contains general instructions as to their meaning and tips on drawing them.

The book is primarily a text for the drafting room student.

"Symposium on Physical Properties of Cast Iron," by the American Society for Testing Materials. First edition, 118 pages, 6 in. by 9 in., paper covered binding. American Society for Testing Materials, Philadelphia, Pa., publishers.

A collection of papers presented at the 32nd annual meeting of the American Society for Testing Materials have been bound together for this discussion on the physical properties of cast iron. The discussions were technical and discussed various research projects. The general discussion on the papers are included at the back of the booklet.

"Highway Curves," by Howard Chapin Ives, C. E., Consulting Engineer. First edition, 247 pages, 4 in. by 6¾ in., semi-flexible binding. John Wiley & Sons, Inc., New York, publishers. Price, $3.50.

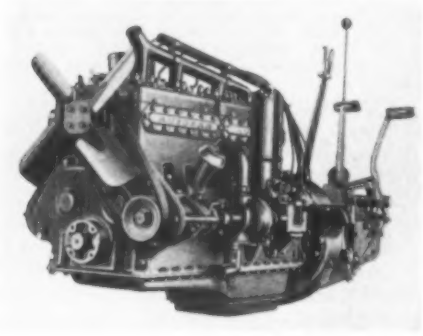
This small volume is about half discussion and half tables. It starts out with a short discourse on highway location and then continues into a treatment of curves, spirals and superelevation. Many standard tables are included some, it appears, by force.

"Symposium on Mineral Aggregates," by the American Society for Testing Materials. First edition, 162 pages, 6 in. by 9 in., paper covered. American Society for Testing Materials, Philadelphia, Pa., publishers.

This collection of papers appeared in Volume 29, Part II, of the 1929 proceedings of the society. At the end of the booklet appears the discussion on the papers. The papers are technical discussions on mineral aggregates.

New Motor Announced

The Autocar Co., Ardmore, Pa., has announced a new six-cylinder motor, called the "Blue Streak," especially designed to meet today's demand for ruggedness and power to maintain sustained speed over long distances. This new Autocar "Blue Streak" six is now



available in all Autocar chasses of 3 tons rated capacity and over.

This new Autocar Six is built in two sizes, 4½-in. and 4¼-in. bore. The 4½-in. engine develops 101 hp. at 2,000 r.p.m. and the 4¼-in. engine develops 90 hp. at 2,000 r.p.m.

A high factor of smoothness in operation is obtained by increasing essential rigidity. The line of the flange joint between the crankcase and oil pan is dropped to 3½ in. below the center line of the crankshaft, thus providing a deep, stiff case. Rigidity is increased further by heavy ribs crossing the bottom of the case, tying the crankshaft bearings to the side walls. The cylinder block has been stiffened too by extending the water jacket wall all the way to the base of the block. Further, this extended water jacket wall furnishes additional support to the base flange of the cylinder block greatly increasing the overall rigidity of the crankcase and cylinder block assembly.

In order further to minimize forces which act on bearings, at high speed, the piston stroke has been kept relatively short. It is 4¾ in. Another important factor of the new design is the shortening of connecting rod bearing offsets from the crankshaft center. This makes greater crankshaft stiffness, and produces an actual overlapping of main and connecting rod bearings.

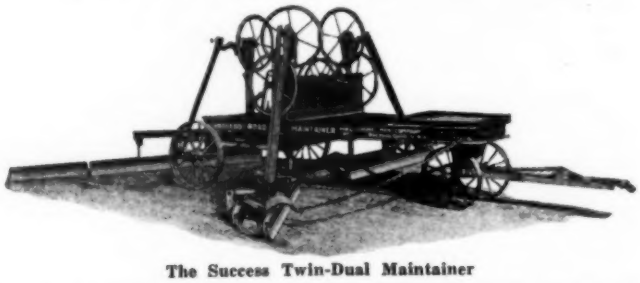
Other new phases are the greater area of cooling circulation, adopting a new principle of water direction; non-expanding and non-corroding nickel chrome iron cylinder blocks, and special silchrome alloy exhaust valves; a fully screened oil pan, with positive oil circulation enforced by an oil by-pass line which provides against stoppage and freezing.

Pistons are fitted with three compression sealing rings and one ventilated oil-seal ring. Connecting rods are drilled for the passage of oil from the bearing to the full-floating piston pin.

Road Maintainer

The accompanying illustration shows a road maintainer that was placed on the market recently by the Shunk Manufacturing Co., Bucyrus, O. The Shunk Manufacturing Co. recently took over the Success Road Machine Co. of Jacksonville, Ill., the company which formerly manufactured and sold the Success maintainer. The machine has been improved by the Shunk engineering staff and was shown for the first time at the Southwest Road Show to be held in Wichita, Kan., Feb. 25-28.

The maintainer, a multiple blade machine, is sturdily built for heavy duty maintenance work. Its frame, built of 6-in. channel steel, is thoroughly braced and riveted. There is stated to be no blade jump or chatter, nor any side draft. The entire weight of the machine can be placed upon the twin-dual blades. The three point draft draw puts the pull low down near the center of blades, where it is most effective. Being a light draft machine a 15-30 hp. tractor affords ample power for operation; a safety pin feature is provided so that greater power may be used without injury to the machine.



The Success Twin-Dual Maintainer

Each set of dual-blades are separately controlled by three large handwheels, easily operated, to raise or lower the heel or toe or to draw them into the machine into a neutral position. The rear blade is also raised or lowered with its own handwheel. Two aditional adjustments offer varied positions for this blade. The large and roomy platform gives the operator free access to all these adjustments.

The twin-dual or multiple blade feature is a patented and exclusive feature of the maintainer. All five blades are double edged, extra wide, high carbon steel, reversible and interchangeable to all positions on the machine. They are concaved ground and polished.

New Maintenance Kettle

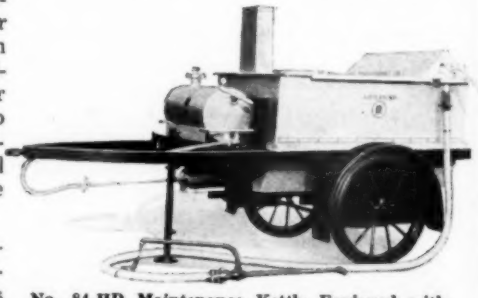
Littleford Bros., manufacturers of the LB line of road maintenance equipment, announce No. 84-HD, a tar and asphalt kettle entirely new in design.

The kettle has double heat circulation from the burner to rear of kettle —then up and back to vent stack. Baffles running between the melting tank and the furnace shell hold the heat down in lower part of heating chamber until it reaches rear of kettle. Then heat is drawn by draft to front of kettle and gases pass out through vent stack. The intense heat is distributed over the entire kettle and every degree of heat is used to the limit before it reaches the vent stack. This even distribution of heat results in immediate melting of asphalt with all danger of over heating or coking material eliminated.

A triangular shaped screen extends the full length of melting tank, and divides the tank into two reservoirs—one for cold material; the other for hot, melted material. The triangular shape of this screen forces the cold material against the sides of the melting tank, thereby getting full effect of the evenly distributed heat caused by the double heat circulation. The material melts immediately and passes down the sides of the kettle as well as through the holes in the screen into the reservoir. Cold asphalt can be added in any quantity at any time without chilling the hot, melted material.

The kettle is made in 110, 165 and 210 gal. sizes. It can be loaded to its full rated capacity.

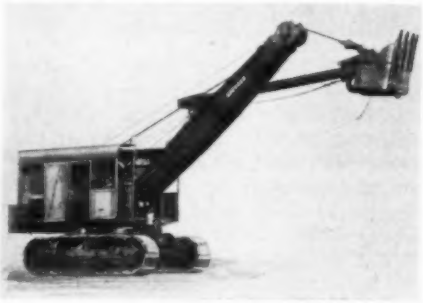
No. 84-HD is mounted on a chassis of unusual strength and trailing quality which is cushioned on semi-elliptical springs—center of gravity of the kettle is lowered and road shock is greatly reduced. Timken roller bearings in the rubber-tired wheels mean that a trailing speed of 20 to 30 miles an hour can be maintained mile after mile with no harm to the outfit. Complete descriptive literature can be obtained from Littleford Bros., 454 E. Pearl St., Cincinnati, O.



No. 84-HD Maintenance Kettle Equipped with Littleford Hand Spray Attachment for Penetration Work, Skin Patching and Crack Filling

1¼ Cu. Yd. Shovel

The Speeder Machinery Corporation, Cedar Rapids, Ia., showed for the first time at the 1930 Road Show the Speeder Model 90 of full 1¼ yd. capacity. The Speeder Model 90 is the result of five years' study by Speeder engineers, and in conformance with the Speeder policy of thoroughly proving a new piece of equipment before offering it on the market the Model 90 has been in actual operation for more than two years.



New Speeder Model 90 1¼ Cu. Yd. Shovel

Some of the features of the Speeder Model 90 are: Timken bearing unit built and friction free throughout; automotive construction; all shafting heat treated and ground to micrometer limits in size; all shafts and hubs splined at important points; all gears, including all bevels and the ring or "bull" gears are cast from special composition steels and machine cut from solid blanks to a mirror finish. All bevel gears are heat treated and hardened, and the traction bevels run in oil in an oil tight cast case; the unit construction allows the removal of drum shafts, vertical shafts, etc., to be removed intact, including bearings, as a unit, thus allowing all repairs and adjustments to be made in the shop on the bench and also allows bearing adjustments to be made without removing the shafts from the machine.

Speeder Model 90, like all other Speeder shovels, has two working speeds on all operations, drums, travel, and swing. Both speeds are direct drives from the power unit and are both actual operating speeds; one, the high speed for shovel work; and the medium speed for crane or dragline work. All drive shafts run at relatively high speeds. The lower frame is a steel casting with machined track with semi-tubular side members closed at the top to exclude dirt. The treads are of extra length, being 14 ft. 6 in. overall. The turntable is 6 ft. 3 in. in diameter, and renewable.

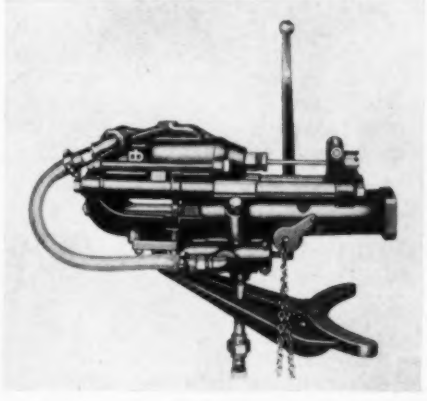
Outstanding features of the Speeder Model 90, other than speed and power, are an automatic swing and travel brake, backgeared and purely automatic. It engages as soon as the swing or travel clutches are released, thus eliminating the burning of reverse clutches. The treads are of extra length, 14 ft. 6 in. overall.

The patented Speeder reversible drum cable crowd is used. This crowding action has all the advantages of the famous Speeder patented double drum crowd and some notable improvements. An automatic power trip for the bucket is another feature of the Speeder Model 90. This trip can be released by the pressure of a finger tip. The rear counterweight is instantly adjustable, which provides correct ballast for long boom work and gives an adjustable tail swing. The machine has a ground clearance of 17 in., yet it is only 11 ft. high from ground to top of cab. Speeder Model 90 is powered by gasoline, electric, or diesel power and weighs approximately 40 tons.

New Shank and Bit Punches

The Ingersoll-Rand Co., 11 Broadway, New York City, has announced a new shank and bit punch known as the 34SP punch. It is designed to fit the No. 34 drill steel sharpener.

The feed cylinder, valve chest oiler, and guide holder are constructed in one piece, and the valve chest is bushed. The short throw and easy reach of the operating lever greatly speed operations. Complete lubrication is maintained from one oil chamber.



34SP Shank and Bit Punch Attached to a I-R No. 34 Sharpener

Stuck pins are eliminated by the positive action, which drives the punching pin out of, as well as into, the steel which is held clamped in the sharpener during the operation. Combination shank and bit guides permit handling both bits and shanks on any one steel section without changing guides and assure the correct alignment of steel to be punched.

With a 34SP punch attached to the No. 34 sharpener, the complete outfit will handle any section of drill steel up to 1⅛ in. in diameter, and will make bits up to 2½ in. in diameter.

New Tractor

The Cleveland Tractor Co., Cleveland, O., has announced its new 80-60 Cletrac. The overall width of the tractor over the track is 96 in. and the overall length is 156 in. The overall height from ground to top of radiator is 82 in. The ground clearance between the lowest part of drawbar and ground is 15 in. without grousers; with grousers 18 in. The tread of tracks (center to center) is 67 in., and the width of tracks is 17 in. The width of grousers is 20 in., and the track length (ground contact) is 97 in. This gives a ground contact of 33 per cent of the total length of track.

The motor is a 6-cyl., 5½-in. bore by 6½-in. stroke, governed at 1,050 rpm.; 119 brake horsepower and 645 ft.-lb. torque; 927 cu. in. displacement. The motor is fully equipped with 12-volt Delco-Remy starting and lighting and single ignition, also Purolator oil cleaner and an A C Breather.

The clutch is the Borg and Beck 18-in. pull type. The transmission is of the selective type and gives three speeds forward and one reverse. At 1,050 governed motor speed, the tractor speed is 1¾ miles per hour low gear, 2½ miles per hour intermediate gear, 3.6 miles per hour high gear and 2.1 miles per hour in reverse.

The gear centers are spread to a wide center distance, making the gears larger in diameter, which eliminates high tooth pressure; also the faces of the gears are ample in width to withstand extraordinary abuse. The shafts are 10-spline type mounted, in double-row, self-contained Timken bearings. In the rear of the transmission case there is an oil pump which pumps the oil from the final drive gear housing, discharging it through a filter and back into the transmission and differential compartment. This pump is driven from the upper transmission shaft. The rear of the lower transmission shaft is sealed to hold oil in this compartment up to its proper level.

The compensating planetary differential is mounted in double-row ball bearings driven by a three to one ratio, straight tooth bevel pinion and gear which is identical in design to other Cletrac models.

New 80-60 Cletrac

Pavegard Announced

Pavegard is Blaw-Knox steel armoring used for obtaining a long wear surface on roads, streets, alleys, courtyards, bridges, bridge approaches and other parts of pavement which are ordinarily subject to extremely heavy wear. The use of Pavegard at points where traffic burden is greatest, reduces

Blaw-Knox Pavegard, a Steel Pavement Armoring

repairs and maintenance costs to a minimum. Busy corners where traffic stops and starts, streets carrying heavy trucking, pavement adjacent to loading platforms, parts of pavements subjected to heavy turning action or abrasion from dragged loads or hand trucking are just the places where Pavegard proves invaluable.

Pavegard is not to be confused with steel reinforcing that is placed in the interior of concrete. It has two functions:

First, it protects the road surface; Secondly, it makes the pavement stronger by presenting a unified steel mat surface to traffic. This is a great advantage where a pavement is subjected to heavy concentrated loads from trucking and bus service.

There are often some parts of otherwise good pavements that fail, either through local weakness or through concentration of load on some particular section. When repairs are made, if Pavegard is built into these sections, a permanent and satisfactory job can be done.

Pavegard is made up of steel strips, which when placed together on edge, form a regular pattern or mesh of proper size to meet the conditions imposed by traffic; thus a protecting mat of steel mesh which is put together easily, quickly and cheaply without the use of tools reinforces the pavement surface by taking the entire wear. Tie-rods hold the strips together in a solid web or mesh, strips being alternately staggered at joints to preserve the continuity of the mat.

Pavegard is assembled direct on concrete, asphalt or other solid base, after which the topping or finishing surface is placed and rolled in the case of asphalt, or trowelled or screeded if concrete. Pavegard cannot be worn away by passing traffic as the steel on edge takes the entire wear. There is no opportunity for holes or cracks to develop or spread. The wear is transferred from the basic material to the steel.

Asphalt surface has a tendency to move or roll with the traffic, particularly during hot weather. Under these conditions wear is excessive and the surface becomes so bad it has to be readjusted. It is obvious that by introducing Pavegard in the surface that no rolling can take place and that the wear of the surface is restricted to the wear of the steel. During the last 3½ years this has been aptly proved in London, England, where Pavegard has been widely used.

Generally speaking, crossroads, corners, bus stops and at all points where traffic starts and stops frequently, there is excessive pavement wear and large maintenance expense, and in these places Pavegard proves invaluable and a great economy for the state, municipality or county.

Following an engineering study of the subject, the City of Chicago has installed a section of Pavegard 10 feet wide and 120 feet long at the busstop on Michigan Avenue at Randolph Street, one of the busiest corners of the world. This section has to withstand the stopping impact every twenty-four hours of 1,600 buses, weighing over 20 tons, and it has been estimated that over 67,000 vehicles of various kinds pass this corner in the course of a day.

This particular installation of Pavegard has a 3 in. mesh, the bars being 1¼ in. deep. This was assembled on a concrete base, to which was added a binder of tar and gravel. The pavegard was then asphalted in with topping and thoroughly rolled as is customary with this character of pavement.

A New Full Revolving Small Shovel

A new full swing ⅜ yd. gasoline shovel has been brought out by the Western Manufacturing Co., 3428 Scotten Ave., Detroit, Mich. The main frame is of heavy, cast steel construction, incorporating the heavy, internal circle gear, with eight rollers. The rollers operate on top of the main frame, unaffected by the dirt and grit that cause trouble where the table turns on top of the rollers.

Aside from the track and engine, 95 per cent of all bearings are of the ball or roller type. Friction losses are kept at the minimum, making more power available for productive work.

The power plant is a 6-cylinder Hercules engine, developing in excess of 50 hp. at 1,400 r.p.m., its governed speed.

The transmission provides two speeds in each direction, and has four power take-off outlets. The lower center shaft drives the shovel mechanism, direct from the engine, at 1,400 r.p.m. The upper center shaft, geared for 750 r.p.m., is used for driving the generator when a magnet is required.

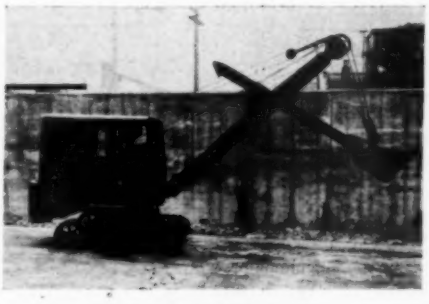
The left hand shaft travels at either 500 or 1,000 r.p.m. in either direction, and operates the fine pitch Buckeye Alligator crawler tracks at one or two miles per hour. Each track is controlled separately by a friction clutch. The power boom hoist is also operated through the transmission, with two speeds available. The auxiliary drum and other attachments may also be supplied with power and independent control.

The hoist, swing and crowd mechanism is mounted on a heavy cast steel frame with center bearing only, permitting easy removal of either clutch or drum mechanism without disturbing the other.

One of the most desirable features of the shovel is its hydraulic control. (A three-lever manual system is optional.) The hydraulic system, of the Lockheed type, the same as is used for automobile brakes, enables the operator to control all shovel operations with a single lever.

In addition to this single lever for all shovel operations there are two brake pedals, for the hoist and crowd, and two control levers for the crawler tracks, all mounted in a single, clean-cut assembly.

In order to take full advantage of the power, speed and versatility of the shovel, a great deal of care has been taken in the design of the special attachments used in converting it to other types of equipment.



The Ace Gas Shovel

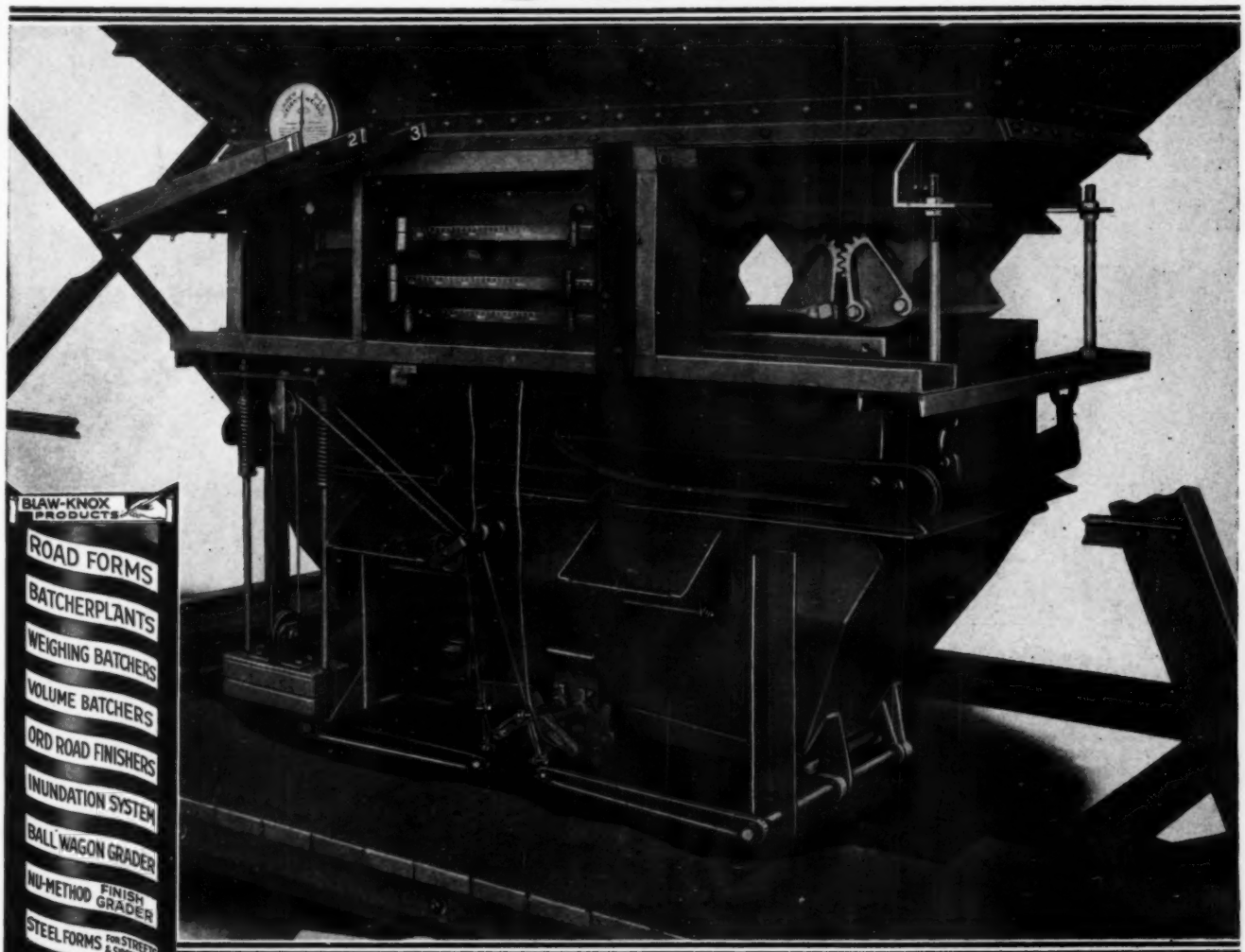
The changeovers have been simplified through the use of an extension boom, standard for all conversions, and special attachments, easily installed. The shovel, therefore, may be used as: power shovel, clamshell, trench hoe, crane, dragline, backfiller, magnet crane.

QUALITY, in WEIGHING EQUIPMENT

originates at

The engineering experience and mechanical thoroughness of BLAW-KNOX has constantly improved, *and perfected,* the WEIGHING BATCHER.

BLAW-KNOX



THE BLAW-KNOX *TRIPLE* WEIGHING BATCHER

BLAW-KNOX PRODUCTS

- ROAD FORMS
- BATCHERPLANTS
- WEIGHING BATCHERS
- VOLUME BATCHERS
- ORD ROAD FINISHERS
- INUNDATION SYSTEM
- BALL WAGON GRADER
- NU-METHOD FINISH GRADER
- STEEL FORMS FOR STREETS & SIDEWALKS
- TRUCK TURNTABLES
- STEEL BINS ALL CAPACITIES
- CLAMSHELL & DRAGLINE BUCKETS
- AGITATOR TRUCK BODIES
- READY MIXED CONCRETE PLANTS

BLAW-KNOX

For the quick and accurate Weighing of one, two, three or more materials; even surpassing rigid specifications.

One man runs a Blaw-Knox Weighing Batcherplant, watches the Tell-Tale Dial, and checks every batch for overweight and underweight---operates rapidly and easily.

Blaw-Knox Weighing Batchers are shipped completely assembled with or without the bin, ready for instant service.

Bulletin No. 1105 gives you the details---Weighing Batchers for Cement and Aggregates---write for it.

BLAW-KNOX COMPANY
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DISTRIBUTOR NEWS

The Distributor's Department in the Gillette Construction Group

Distributor Close-ups

The firm of John C. Louis Company, Inc., is not, in point of years, very old. The name of John C. Louis, however, has for many years been well known to the trade in and about the cities of Baltimore and Washington, and the territory adjacent thereto.

Mr. Louis was born and raised in Baltimore, and started his career in the equipment business with a large contractors' supply house located in that city, making many friends among the buyers. He was always eager to develop a business of his own, and on November 1st, 1903, his ambition was realized when he opened his own machinery and equipment business.

John C. Louis, President of John C. Louis Co., Inc., Baltimore

The young men composing his sales force and who through their loyalty and hard work assisted in building up the business, were in 1927 allowed a share in the ownership when it was incorporated under the name of The John C. Louis Company. One of these men was George J. Schmidt, who joined the company in 1912 as a stock clerk. Mr. Schmidt is now secretary of the company.

George J. Schmidt, Secretary, John C. Louis Co., Inc., Baltimore

Interior Office View of the John C. Louis Co., Inc., at 221 S. Eutaw St., Baltimore

This company is located at 221 South Eutaw Street, Baltimore, where orders for contractors and builders supplies are filled with neatness and dispatch.

Not the "man with the hoe," but the "man with the pipe" is presented with this story, and he happens to be Mr. K. B. Hubbard, president of The K. B. Hubbard Company, Inc., of Lansing, Michigan.

K. B. Hubbard, President, the K. B. Hubbard Co., Inc., Lansing, Mich.

Although young in point of years as an organized company, this organization is not young in experience in the equipment business, for Mr. Hubbard was for many years a sales representative for the Good Roads Machinery Company in New York territory, and also in Chicago territory, until he founded his own business in 1928.

Through Mr. Hubbard's efficient direction the K. B. Hubbard Company is one of the up and coming contractors' equipment houses in Michigan, with warehouse facilities located at 214 West Kalamazoo Street, Lansing.

Believing in "The Magic of the Blue Grass," the Frankfort Company Inc., chose the good old state of Kentucky as their center of activity. Kentucky! That treasure chest of mineral wealth and undeveloped resources, where the finest of early American traditions are preserved.

W. J. Hulette, Secretary and General Manager, the Frankfort Supply Co., Inc., Frankfort, Ky.

For many years the Frankfort Supply Company, Inc., located in the city of Frankfort have supplied to contractors and road builders of that state, and the surrounding territory, many of their requirements for carrying on their work. They own and operate their own rock crushing plants, where the crushed products are prepared for sale to the trade. They have in operation now three Climax crushers one of which Mr. Hulette says has seen eleven years of continuous service. A 45 foot long, 18 inch wide bucket elevator is now being installed at one of the plants.

Make it *minutes*, not *miles* to Market

SEVENTY-FOUR per cent of American farmers still live on dirt roads. Their produce travels to market much more slowly than that of the lucky 26 per cent who live on smooth, modern highways. Waste is greater; delivery later. That means that costs—and prices—are higher, and profits lower.

This farm-to-market road problem can be solved—is being solved by hundreds of communities which have adopted Tarvia "Re-Tread" programs.

Tarvia "Re-Tread" enables any community to have easy-riding, traffic-safe, storm-proof highways—quickly and without excessive taxation. No elaborate organization or expensive equipment is necessary to do a perfect job with "Re-Tread."

The Tarvia field man will gladly give you the details. 'Phone, wire or write our nearest office.

The Barrett Company

New York	Chicago	Philadelphia
St. Louis	Minneapolis	Boston
Detroit	Cleveland	Birmingham
Buffalo	Columbus	Milwaukee
Providence	Syracuse	Cincinnati
Baltimore	Toledo	Rochester
Lebanon	Youngstown	Bethlehem
		Hartford

In Canada:
THE BARRETT COMPANY, Ltd.
Montreal, Toronto, Winnipeg, Vancouver

Tarvia "RE-TREAD"

TRADE MARK REG. U. S. PAT. OFF.

Printed in U.S.A.

Frankfort Supply Company are practical, business-like boosters for their old home state, actively represented by their president, Mr. Clarence Julian, and Mr. W. J. Hulette, secretary and general manager.

Another company giving a good account of itself in a southern state is the Wilson-Weesner-Wilkinson Company of Nashville, Tennessee. Maybe W-W-W also stands for "We Will Win" for we are told that every man in the organization is a go-getter who "gets."

The "Three 'Ws'" handle road building machinery, earth and rock handling machinery and equipment, crushing machinery and concrete machinery and supplies. It is said that their yearly business in reinforcing bars and mesh for concrete work alone, would be considered a good business.

M. A. Weesner, President, Wilson-Weesner-Wilkinson Co.

Tennessee has a big road program under way and Wilson-Weesner-Wilkinson with warehouse facilities in Nashville, Knoxville and Memphis, and a sales office in Jackson, undoubtedly has some busy days ahead. General headquarters, with warehouse facilities, are located at 108 Fatherland Street, Nashville.

Mr. M. A. Weesner is president of the organization. Mr. Tom Osborn, formerly with Asheville Foundry Company, and well known in the construction business, is manager of the Knoxville branch.

Before leaving the atmosphere of the old south, mention must be made of the Tractor and Machinery Company of Atlanta, Georgia. The head of this firm is Mr. Albert E. Hahnan who, report has it, not only is well acquainted with contractors, roadbuilders and quarrymen throughout his own state, Alabama and South Carolina, but he knows all the members of the family. Perhaps he is anticipating the time when they will all be needing his services.

Wilson-Weesner-Wilkinson Company Headquarters at Nashville

Mr. Hahnan has been in the south for a number of years, in which territory he represented the Good Roads Machinery Company. In 1926 he organized the Tractor & Machinery Company. The well equipped warehouse is located at 351 Whitehall St., S. W., Atlanta.

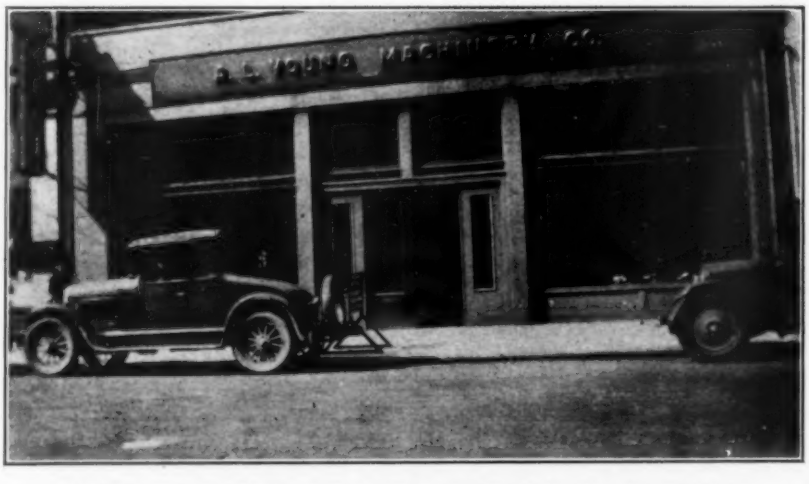
During the late unpleasantness occurring somewhere west of the Rhine, Mr. Hahnan is said to have handled the machinery in his care to considerable advantage. He knows his machinery.

Next we go clear out to the Golden Gate to present a picture of the A. L. Young Machinery Co., located at 26-32 Fremont St., San Francisco. This company was founded in 1906 by A. L. Young and a group of associates, who are now deceased, but the original name is still retained.

Mr. L. E. Murphy, who has been connected with the firm for about 12 years, is now its president. The secretary is Mr. E. B. Spread, who has a record of 10 years with the company. The lines handled include contractors' equipment and concrete, road and ditching machinery, and the firm also specializes in woodworking and box-nailing machines.

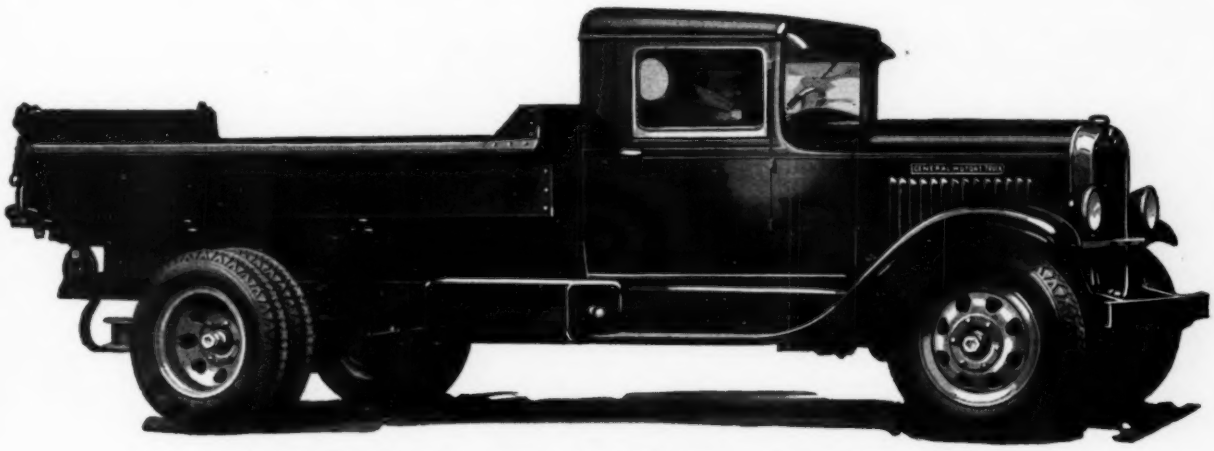
An interesting item about the picture shown is the fact that the building was one of the very first erected after the earthquake and fire that entirely swept away this section of San Francisco in 1906. In their offices hangs a photograph taken the day following the quake and fire. Directly in front of the building, at the time the earthquake began, a drove of cattle was being driven to the stockyards. The photo shows the bodies of these steers covered by the debris from the collapsed buildings, including, of course, the one that their present structure replaces.

Show Rooms and Offices of the Tractor & Machinery Co.



Display Rooms and Offices of the A. L. Young Machinery Co., San Francisco

RUGGED AND POWERFUL



$2080—3-TON RANGE

Model T-44 A

Price, Chassis Only, F.O.B. Pontiac, Mich.

THIS model is available in four wheelbases — 141″ (illustrated), 152″, 164″ and 181″—and 12 different tire combinations. Chassis prices vary according to wheelbase and tire equipment. Straight Rating—15,000 lbs.—total gross weight including load.

. . . it asks no quarter and gives none in tough, hard duty!

WHERE POWER counts mightily, with loads in the three ton range to be moved with safe, modern speed, the General MotorsTruck, Model T-44, is *the* truck for the work.

Put it on the toughest job you've got and this rugged worker will lick it—and *keep it licked for years.*

In dump and tractor work it excels—because of the tremendous *tractive ability* of its famous 6-cylinder engine. A steady, vibrationless flow of power is achieved by a torsional balancer and counterweighted crankshaft.

Throughout its construction there is the brute ruggedness that a truck *must* have to stand up in this industry . . . extra margins of strength in the burly frame, which has 5 husky cross members—with a "stress absorber" spreading shocks at the point of maximum strain . . . big, long rear springs, with auxiliary springs providing easier riding throughout the entire load range, and counteracting sidesway . . . an exceptionally sturdy rear axle that stands the gaff . . . 4-speed transmission of proved durability . . . quick-acting 4-wheel brakes, simple to adjust . . . a rugged, simple clutch . . . easy steering and unusually short turning radius . . . roomy comfortable driver's compartment . . . quiet, weather-tight cab.

It all adds up to tremendous value. Value can't be touched in the 3-ton range. *It's certainly worth seeing and investigating!*

GENERAL MOTORS TRUCKS

TIME PAYMENTS, on any General Motors Truck, are financed at lowest rates available anywhere, through our own Yellow Manufacturing Acceptance Corp.
GENERAL MOTORS TRUCK CO., Pontiac, Michigan (*Subsidiary of* Yellow Truck & Coach Mfg. Company) GENERAL MOTORS TRUCKS . . . YELLOW CABS . . . COACHES.
Factory Branches, Distributors, Dealers — in 1500 principal cities and towns.

A MODERN TRUCK FOR EVERY PURSE AND PURPOSE

Representing the Robert T. Twedt Co., Inc., Cheyenne, Wyo. Mr. Twedt the Central Figure

The picture of headquarters of the Robert T. Twedt Co., Inc., is known as the "old fort building" and was one of the first buildings put up in the pioneer days of Cheyenne and it is well known by the pioneers and older stockmen of the state.

Mr. Robert Twedt, president of the company, is shown in the center of the group with his salesmen standing at each side. Mr. Twedt, who is a native of the west, has traveled the states of Wyoming and Colorado for the past 12 years.

In December, 1928, he took over the dealership for that territory of "Caterpillar" products and other equipment, locating in Cheyenne in the building shown in the picture. "Good Roads" products for this territory are also handled by this company.

Now located at 1621-23 Locust St., Kansas City, Mo., the Industrial Machinery Co. continues to serve the same territory covered as when located across the river in Kansas City, Kan.

Mr. E. J. Anderson is president and general manager of this organization, which handles all kinds of machinery and equipment for contractor and road-builder. A well equipped, modern warehouse assures efficient handling of customers' needs.

H. Y. Smith, President, H. Y. Smith, Inc., Milwaukee

As the middle-west is not to be passed over lightly attention is called to the H. Y. Smith Company, Inc., Milwaukee, Wisconsin.

A number of years ago, Mr. H. Y. Smith organized the company which bears his name and of which he is the president. In a state noted for its good roads, the name of the H. Y. Smith Company is well known as a source of supply for equipment and supplies needed by road builders and contractors. They have made quite a record in disposing of portable and mobile gravel plants.

The general office of this company is located at 1301 First National Bank Building, Milwaukee.

Here we present a picture of Mr. W. T. MacDonald, president of W. T. MacDonald Co., of the capital city of the good old state of Indiana. 48 N. Senate Ave., Indianapolis, is the address, to be exact.

If Mr. MacDonald's middle initial was "D" instead of T, it would surely

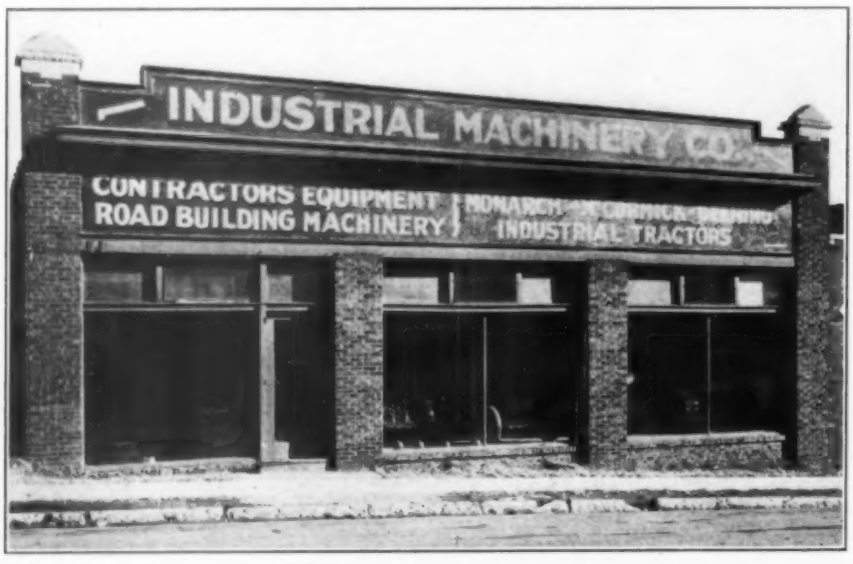
W. T. MacDonald, President, W. T. MacDonald Company, Indianapolis, Ind.

stand for Dependability, for his organization has gone steadily forward from a small beginning to one of the best known equipment firms, and the attribute of dependability has played no small part in its success.

Among other lines handled by this company are those of Barber-Greene, Butler Bin and Good Roads Machinery Companies.

Another mid-westerner is Mr. E. C. McAllister, president of the Mid-West Tractor & Equipment Co., 2701 S. Wabash Ave., Chicago.

This is one of the younger distributing companies handling construction equipment, having organized in January, 1928. They cover northern Illinois and some Indiana territory, and handle Coleman trucks, Smith crawler wagons and "Cletracs," as well as other lines of well known equipment.



Show Rooms and Warehouse of Industrial Machinery Co., Kansas City, Mo.

When you have a tough road job on your schedule—and you're rushed for time—*then* you'll appreciate fully the super-strength and super-power of a HUBER Motor Roller. Huber engineers anticipated every emergency demand when they designed this modern motor roller. For speed, economy of operation, and general adaptability—you can't beat a HUBER! *Low first cost. Low maintenance.* Write for your copy of the new HUBER Motor Roller catalog.

THE HUBER MANUFACTURING CO.
355 E. CENTER STREET, MARION, OHIO

HUBER
MOTOR ROLLERS

E. C. McAllister, President, The Mid-West Tractor & Equipment Co., Chicago

The last story of the group is one not only of distribution of equipment, but of manufacturing as well. It concerns activities in the state of Oklahoma, other than those with which the justly famous Will Rogers is identified. It is about the Muskogee Iron Works, which started as a small concern twenty-one years ago, with light equipment and a few employees. It has grown and expanded from year to year, until it is now one of the largest institutions of its kind in the southwest.

Fourteen years ago S. M. McManus, president, took charge of the plant and the remarkable growth of the institution is due largely to his wisdom and foresight as an executive, according to a statement made by one of their officials. Muskogee Iron Works structural steel products are being sold in a territory which includes not only every state in the Union, but numerous foreign countries. The latest expansion of the Muskogee Iron Works was the absorption of the Oklahoma Foundry & Engineering Co., manufacturers of trailers, tractor and truck winches, power take-offs, hoisting equipment, etc.

In 1925 Muskogee Iron Works took over the manufacturing and distribution of the Towner line of maintainers, together with the distribution of the machinery accounts formerly handled by L. B. Towner & Sons. Mr. Herbert B. Towner became manager of the road machinery department. In addition to the Towner line of maintainers they

Herbert B. Towner, Manager Road Machinery Department, Muskogee Iron Works, Inc.

are building the Oklahoma line of patrol graders. Among the machinery accounts which came to them through the L. B. Towner Co. was that of the Good Roads equipment. They have worked out and are selling to the Oklahoma State Highway Department a portable rock crushing unit for crushing the roadside rock so abundant in certain sections of the state.

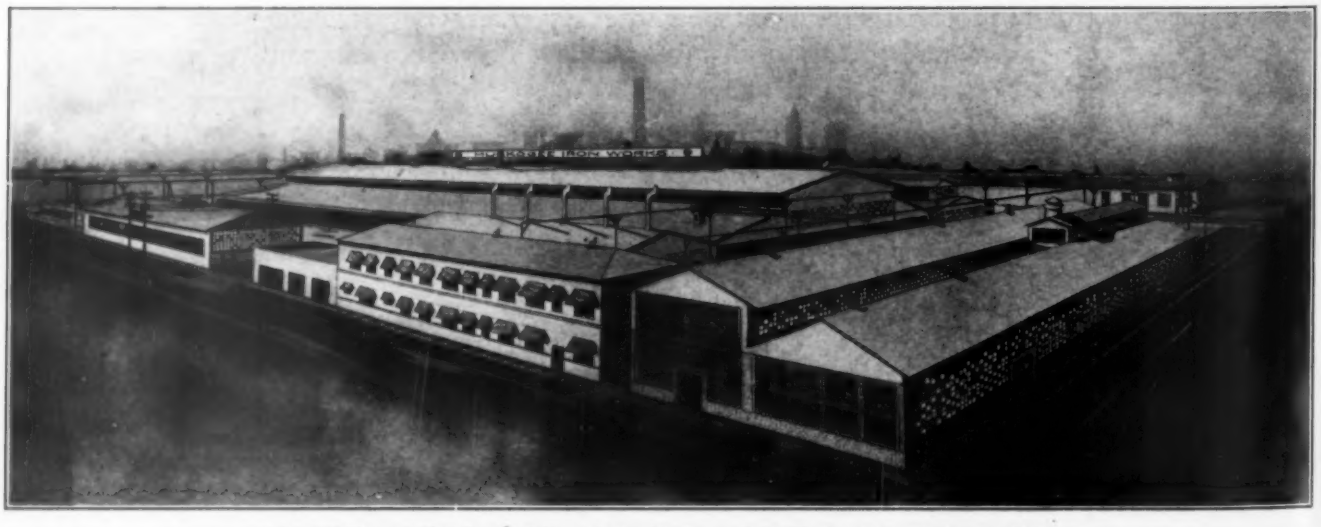
Universal Portland Makes Personnel Appointments

Appointments in the sales department of the Universal Atlas Cement company, a sudsidiary of the United States Steel corporation, were announced today by F. L. Stone, general sales manager. The company was formed this year through the union of the former Atlas and Universal organizations. The sales appointments announced by Mr. Stone follow:

O. H. D. Rohwer, heretofore division sales manager of the Universal Atlas company, is appointed an assistant general sales manager. A. C. Cronkrite, who has been assistant general sales manager, continues in that position. The new appointment is due to the increased business caused by the joining of the Universal and Atlas organizations. Mr. Rohwer for twenty years was connected with the former Universal Portland Cement company. Starting in the St. Louis office in 1907, he was successively salesman, special representative on contract work, special representative in Kentucky and in Detroit, and division sales manager with territory in Wisconsin, Iowa, Kentucky and Tennessee.

Before going to Universal he was with the Missouri Pacific railroad for ten years in various departments. He also was general agent in New Orleans for the American Refrigerator Transit company, which was affiliated with the Missouri Pacific. In addition to his selling experience in the cement and coal fields, Mr. Rohwer for three years was in the sales departments of powder companies controlled by the DuPont and Peabody interests. In his new position as assistant general sales manager, Mr. Rohwer will have his office with the headquarters of the Universal Atlas company in Chicago.

N. A. Kelly, previously sales manager at New York for the former Universal Portland Cement company, is appointed to the same position with the



View of Plant and Office Building of the Muskogee Iron Works, Inc., Muskogee, Okla.

Practical Power for Motor Graders

Model LH Trackson McCormick-Deering is correctly designed for motor grader operation. Because of wide clearance between tracks and motor the grader frame can be mounted between them, thus insuring correct control and best results at the blade. Differential gears in rear end assure easy steering through front wheels of grader. No complicated clutch hook-ups necessary. No extra operations when turning. Corrugated track shoes provide ample traction without marring road surface. For unusual conditions one-bolt grouters can be quickly attached. No matter what grader you have or intend buying let us show you why Trackson Crawlers will improve its performance.

TRACKSON COMPANY

1315 South First St. **Milwaukee, Wis.**

TRACKSON
McCORMICK-DEERING

FULL CRAWLERS « BULLDOZERS « SHOVELS « LOADERS « CRANES « HOISTS

enlarged organization. He was associated with the sales department of the Universal company for eighteen years. He began in 1911 as sales representative in New York state, working out of the Pittsburgh office. In 1916 he was named division sales manager in charge of the company's sales force in New York and other eastern states. In 1929 he was made sales manager at New York with supervision of sales in eastern territory. With his long experience and many contacts in eastern markets, Mr. Kelly is well fitted to direct the enlarged sales operations in that area that results from the union of the former Universal and Atlas organizations.

A. O. Stark, appointed assistant sales manager at New York for the Universal Atlas company, was connected in a sales capacity with the former Atlas company for more than twenty years. As assistant eastern sales manager and export manager for Atlas, his activities were chiefly in eastern territory and in foreign fields. Prior to the war he was placed in charge of the exportation of Atlas products and since that time continued his supervision of export activities. He has traveled extensively in Latin American countries and is familiar with foreign trade conditions as well as enjoying a wide acquaintance in the domestic construction industry.

William A. McIntyre, for eleven years a sales executive for the former Atlas company and experienced both in engineering and in selling, has been appointed to direct the sales forces working out of Philadelphia for the Universal Atlas company. He is a graduate in engineering from the University of Pennsylvania. He was engineer for the United States war department in dredging the Delaware river and New York harbor. As secretary of the committee on portland cement during the war he handled all government allocations of cement. From 1912 to 1916 he was chief road engineer for the Portland Cement association. Since 1919 he has been engineer and manager of the Philadelphia office of the former Atlas company.

Galion Elects New Officers

The annual meeting of The Galion Iron Works & Mfg. Co., Galion, O., was held recently and the following officers were elected.

Mr. D. C. Boyd, chairman of the board; Robert W. Gillispie, president; John L. Connors, vice-president and general manager; J. S. Boyd, vice-president; R. E. Boyd, works manager; J. X. Farrar, secretary, and H. Supp, Jr., treasurer.

Mr. Frank W. Faber, who had been secretary and treasurer for more than fifteen years, resigned his office to engage in other activities.

Mr. John L. Connors has been serving as assistant general manager of The Galion Iron Works & Mfg. Co., and also holds the same position in The Jeffrey Manufacturing Company of Columbus, O.

Mr. H. Supp, Jr., the new treasurer of the company, is also treasurer of The Jeffrey Manufacturing Company and Mr. J. X. Farrar, the new secretary, is credit manager of The Jeffrey Company.

The Galion Iron Works & Mfg. Co. is one of the largest manufacturers of road machinery, including a full line of pull and power graders, road rollers, culvert pipe and kindred equipment.

J. Harry Barbazette

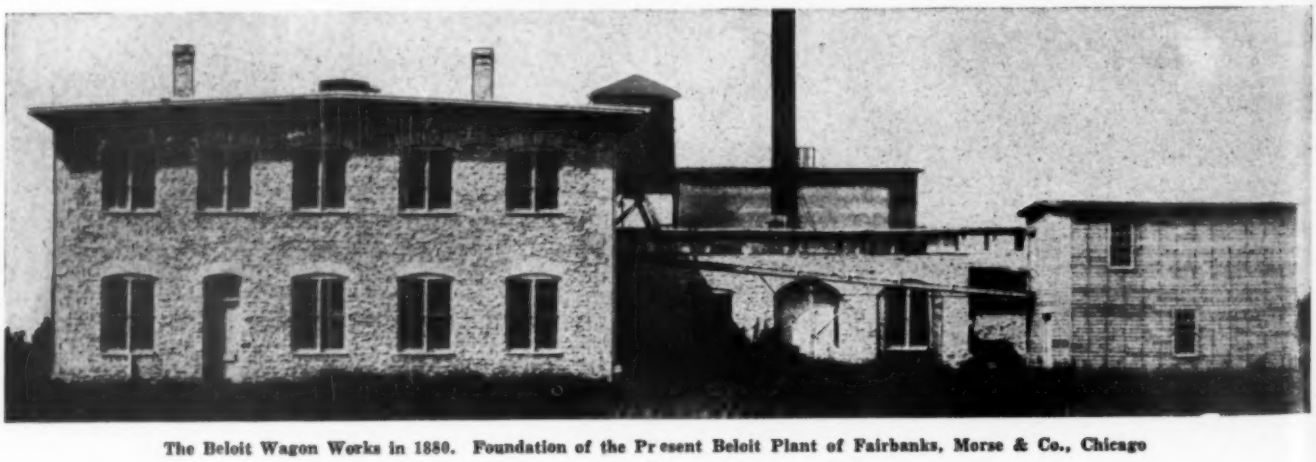
J. Harry Barbazette, manager of operations in charge of the western division mills of the Alpha Portland Cement Company, died at his home, 5531 Lakewood avenue, Chicago, March 4. "Barb," as he was familiarly known among his host of friends, was one of the best known and liked officials in the cement industry. His jovial disposition and sparkling wit made him popular with every one he met, and because of his technical knowledge of cement production he was recognized as one of the leading engineers in that field. He practically grew up with the cement industry, starting his career in it twenty-six years ago.

Mr. Barbazette was born in Beardstown, Ill., forty-seven years ago. His parents later moved to Terre Haute, Ind., where he received all his schooling. He was graduated from the Rose Polytechnic Institute of that city as a mechanical engineer in 1904. Immediately following his graduation, he became associated with a cement company at Speeds, Ind., leaving this connection a year later to take a position with another cement concern at Iola, Kan.

In January, 1909, he joined the Universal Portland Cement Company as superintendent of construction of their plant No. 6 at Buffington, Ind. Four years later he was sent to Duluth, Minn., as superintendent of the Universal's plant at that point. Following this connection, he was employed by the Mid-West Credit and Statistical Bureau for several years, leaving to take the post of assistant sales manager of the Lehigh Portland Cement Company, Chicago, which he held until March, 1920. "Barb" then went with the Alpha Portland Cement Company, where he soon was promoted to the important position he held until his death. He has held appointments on several important committees of the Portland Cement Association, one of which was the committee on papers for mill sessions.

Mr. Barbazette is survived by his widow Marie, four sons, John, a student at Notre Dame, Robert, Louis and William, of Chicago, and his mother, Mrs. Anna Barbazette, and brother, Dr. Leon F. Barbazette, of Terre Haute, Ind. He was a member of the Bob o' Link and Briergate Country Clubs of Chicago.

The Portland Cement Association announces the appointment of Mr. William G. Hudson as district engineer in charge of association work in the states of Louisiana and Mississippi with offices in the Hibernia Bank Building, New Orleans, La. Mr. Hudson has been a member of the field staff of the New Orleans office since 1923, residing at Shreveport. He is a native of Tennessee and is well known in the building industries in Louisiana and Mississippi.

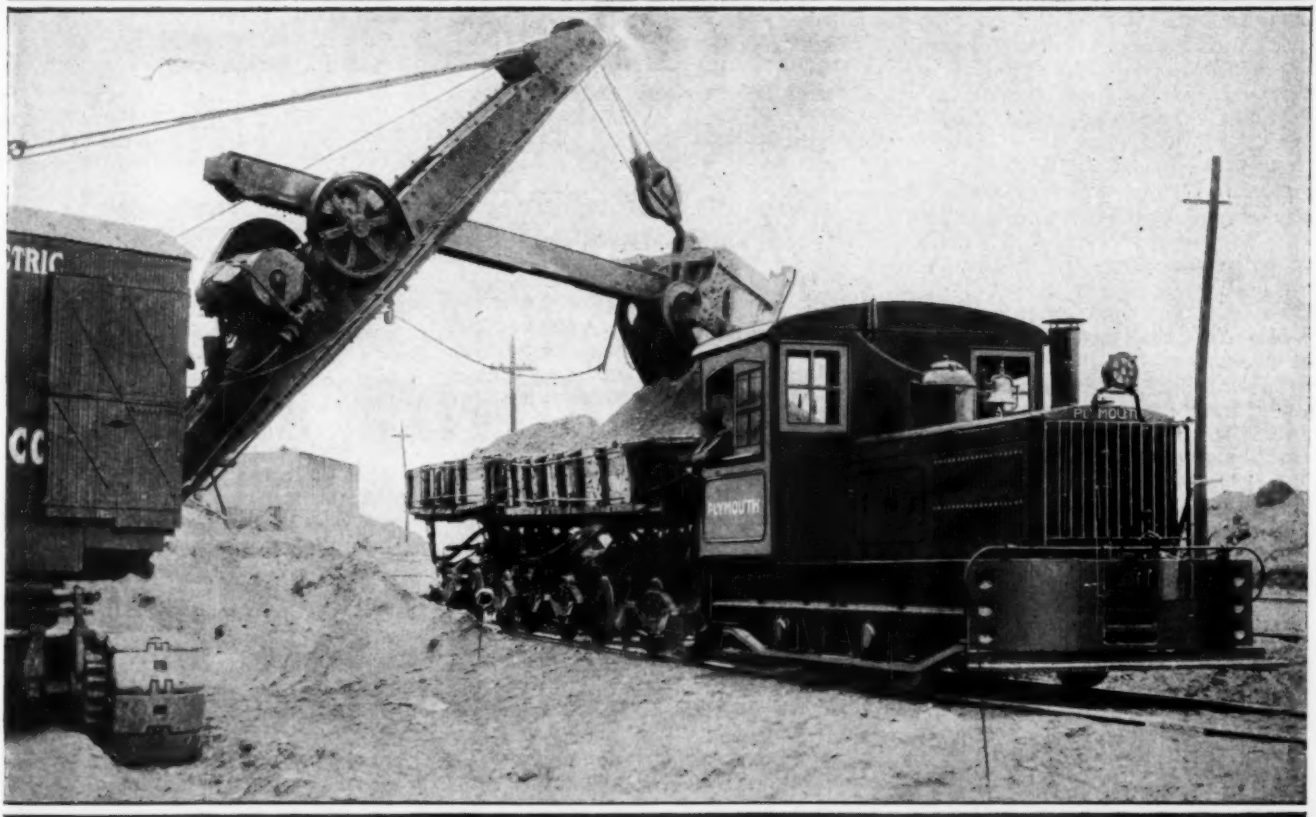


The Beloit Wagon Works in 1880. Foundation of the Present Beloit Plant of Fairbanks, Morse & Co., Chicago

Modine

A MODINE Product

TURBOTUBE



Radiators

1 TO 1000 H.P. AND MORE . ANY TYPE

MODINE MANUFACTURING CO., Racine, Wisconsin

Pacific Coast Representative:
F. SOMERS PETERSON, 57 California St., San Francisco, Calif.

Copyright 1930, Modine Mfg. Co.

About the Cement Institute

The Cement Institute is an association of manufacturers of Portland Cement, with general offices at 11 East 44th St., New York, N. Y.

The Purposes of the Institute, as set forth in the Articles of the Association, are as follows:

To promote the best interests of the cement industry by providing facilities for collecting, through voluntary action, information with respect to trade and commerce therein, and disseminating such information among the members of the Institute and the public generally. The information, so collected and disseminated, shall be as follows:

(a) Information concerning credits.

(b) Information concerning actually closed specific job contracts and other contracts for the future delivery of Portland Cement.

(c) Information concerning production and stocks on hand of clinker and Portland Cement and shipments of Portland Cement, and cloth sack returns.

To collect and disseminate such other and further trade information as the Institute may determine upon from time to time in accordance with the provisions of these Articles of Association.

To adopt and promulgate a Code of Ethics for the government of the members.

To establish and maintain all such lawful trade customs and usages for the protection of the members as the Institute may deem advisable.

To adopt lawful plans for the general development and improvement of the industry.

Any person, firm or corporation regularly engaged in the manufacture and sale of Portland Cement is eligible to membership.

The officers of the Institute are:

President—Blaine S. Smith, President Pennsylvania-Dixie Cement Corp.

Vice President and Treasurer—Morris Kind, President Hercules Cement Corp.

Vice President—M. C. Monday, President Hermitage Portland Cement Co.

Vice President—Chas. Irvin, Vice President Alpha Portland Cement.

Vice President—J. A. Lehaney, Vice President and Manager Lone Star Cement Company (Kansas).

The above officers, together with the following, are members of the Board of Trustees:

G. S. Brown, President of the Alpha Portland Cement Company.

George F. Coffin, Treas. and Gen. Mgr. Nazareth Cement Co.

Charles Schmutz, Vice President Bessemer Cement Corporation.

Col. E. M. Young, President Lehigh Portland Cement Company.

In addition to this New York office, the Institute has offices at present in Chicago, Illinois, and Kansas City, Missouri.

Col. Wm. J. Donovan is counsel for the Institute.

Luther G. McConnell is General Manager of the Institute.

George H. Reiter is Manager of the Chicago Division and Baxter D. McClain is Manager of the Kansas City Division.

Sullivan Exhibiting at Mexico Road Show

Among the manufacturers exhibiting at the Mexico City Road Show to be held in April under the auspices of the American Road Builders Association and the Comision Nacional de Caminos of Mexico, will be the Sullivan Machinery Company of Chicago.

The exhibit will be in charge of Mr. O. J. Neslage, manager of the Mexico City office, which is located at Edificio Cook Dept. 215. Practically all the equipment shown by this manufacturer will be taken from the Sullivan warehouse at Mexico City, where a complete assortment of compressed air, construction and mining equipment is to be found at all times.

The equipment to be exhibited at the Show as announced by the manufacturer includes: Two sizes of vibrationless portable air compressors; a single stage stationary belt driven compressor; two types of all hammer Sullivan drill sharpening machine, and oil heating furnace for heating steel; several models of Sullivan rock drills, concrete breakers, etc.; and several types of compressed air portable hoists.

A. M. Byers Increases Sales Force

Mr. L. M. Johnston, vice-president of the A. M. Byers Company of Pittsburgh, announces that in order to meet the growing demand for wrought iron piping it has been necessary to increase the personnel of the Byers sales organization. Mr. Johnston announces the following appointments:

D. S. Sampson assigned to the New York office, under Division Manager G. W. Hamill, to cover New Jersey territory.

R. C. Hamlett assigned to New Orleans, under jurisdiction of Division Manager A. D. Sheere of Atlanta.

Irwin P. Young, with headquarters in Chicago, under Division Manager M. G. Henderson.

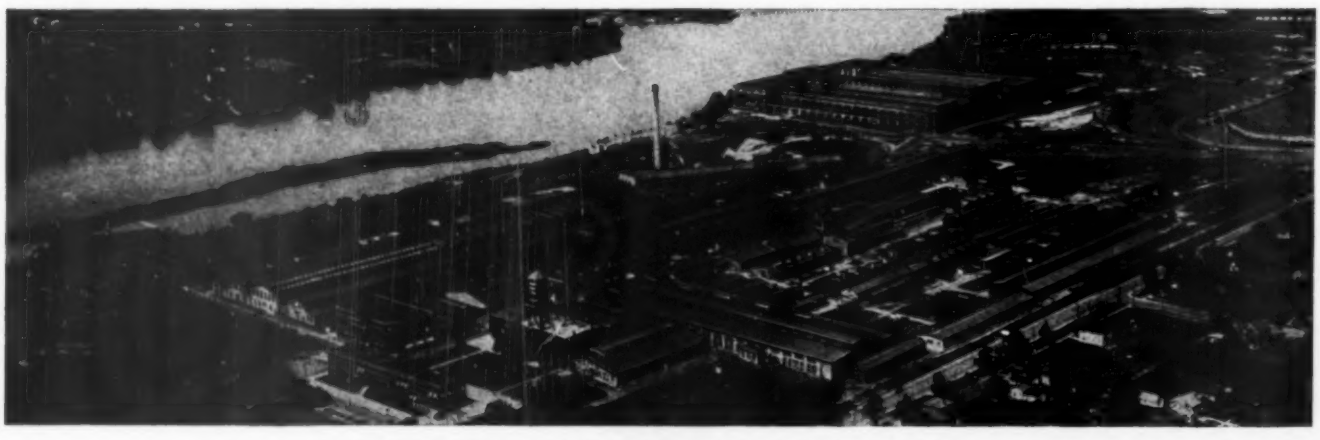
T. D. Graham to St. Louis territory, under Chicago Division Manager M. G. Henderson.

Crawford Brown Joins Autocar Company

The Autocar Company, motor truck manufacturers of Ardmore, Pa., announce the appointment of Crawford Brown as manager of the company's Bronx (N. Y.) direct factory branch, located at 458 E. Fordham Road, New York City.

Mr. Brown has had long experience in the sale and servicing of motor trucks and is well known in the territory served by the Bronx branch, comprising the counties of Bronx, Westchester, Rockland, Orange, Dutchess and Putnam.

Foote Bros. Gear & Machine Company of Chicago orders thus far for 1930 exceed those of the same period in 1929 by 30 per cent, according to W. C. Davis, president. All plants of the company are operating at capacity with sufficient orders on hand to insure production at full speed for the next 90 days.



The Beloit Works of Fairbanks, Morse & Co. as It Appears Today

COLAS TRIUMPHS IN FRANCE

LA Place de Triomphe and l'avenue des Champs Elysees are Colas-built — a significant fact in view of the triumph Colas has won in France. The use of this outstanding cold asphalt road emulsion by French engineers has grown steadily in the past five years until today thousands of miles of French roads are built with Colas.

All over the world Colas has proved its merit — withstanding floods, extreme heat and cold, sudden temperature changes, in fact, every climatic condition. It is attaining an equal record in America. If you are responsible for the construction and maintenance of roads you should know more about Colas. Write for literature and specifications.

FLINTKOTE ROADS INC.

(COLAS LICENSEES)

Pershing Square Building, New York — Park Square Building, Boston

Associated Companies Throughout the World

COLAS
REG. TRADE MARK

BUILDS · DURABLE · LOW-COST ROADS

SERVICE EXCHANGE
For
Manufacturers or Distributors

Editor's Note.—From time to time we receive letters from distributors wishing to be put in touch with manufacturers of certain lines of equipment, or from manufacturers seeking representatives for their products. Items of this kind will be published and names and addresses furnished interested persons upon request.

New Lines Wanted

Distributor thoroughly familiar with bituminous materials and equipment for handling, wishes to add to present lines. Covers Wisconsin and Illinois territory.

Manufacturer's representative with 25 years sales experience, conversant with all types of pumps and their field, desires agency for either New York or export territory, or both.

Distributor covering New Jersey and New York territory would like to secure a line of street markers or other traffic equipment on exclusive basis.

Equipment distributor in Pacific Northwest desires line of road building equipment, structural building equipment, dump bodies and truck hoists.

Distributors of contractors' and builders' machinery and equipment are seeking line of road forms, road finishers, batcher plants, clamshell buckets and drag line buckets, for northern California terirtory. Now stocking equipment for several well known machinery manufacturers.

Manufacturers' agents representing well known lines of water works equipment desire to secure line of pipe pushers and other similar equipment for California and western Nevada territory.

Road machinery distributor would like to secure exclusive sales rights for state of Mississippi for line of automatic or self-loading wheeled scraper.

A Michigan distributor, with many years' experience, representing at this time prominent manufacturers of pumping machinery, offers the services of an established representative to manufacturers needing increased facilities in this region.

Equipment distributor located in Michigan desires to add two or three good lines to serve territory in southeastern part of state.

Wanted for Buffalo, Niagara Frontier and Western New York territory a good power and heating boiler account.

Distributor of building specialties covering a territory of 100 mile radius from Chicago is equipped to represent additional lines.

Machinery distributor established in Porto Rico and Santo Domingo would be pleased to make arrangements to take on new lines in these territories.

Machinery company in the east is interested in representing established lines of road machinery, with the exception of graders.

Representatives Wanted

Manufacturer of cut to length, easily erected standardized steel highway bridges, for spans up to and including 40 feet, which are sold to highway commissioners and superintendents, has attractive territory open in states south and west of Chicago.

Manufacturer of Transverse Testing Machines desires to build up distribution organization in this country and abroad.

Manufacturer of plows, grade-rippers and scrapers desires representation in Arizona, New Mexico, Arkansas, Kansas and Louisiana.

One of the leading manufacturers of surveying instruments in the United States is seeking responsible agents in all sections of the country. Instruments are nationally advertised in all leading engineering journals.

Manufacturer of paving expansion joints is seeking distributors and manufacturers' agents in good, unassigned territory.

Manufacturer of air compressors and contractors tools has number of desirable territories open. Full co-operation will be extended to distributors.

Manufacturer of patented reflecting signs and devices desires representative for New York City, Long Island, Westchester County and adjacent territory. Some one selling other products to municipalities preferred.

District representatives wanted for sanitary engineering specialty used extensively in the water works, sewage and swimming pool fields.

Manufacturer of patented luminous highway danger signs and signals is interested in securing aggressive representation in various parts of this country and Canada.

Manufacturer of contractors and builders levels and transits is seeking district sales manager. Exclusive contract given. Excellent territory still available. Backed by national advertising.

Well established manufacturers' representatives wanted to handle sand and gravel pumps and equipment, in key cities, by successful manufacturer of high grade dredging pumps and hydraulic dredging equipment. Give character of equipment now being handled and territory covered.

Manufacturer of hoisting machinery and air compressors has open territory in New York and New England states for aggressive distributor.

Distributors wanted for deep-well turbine pumping unit. Product serves small industrial plants, private estates and farmers.

Manufacturer of water works brass goods would like to make proposition to manufacturers' representatives calling on water works' trade.

Attractive territory available for experienced men to handle contractors' labor-saving equipment by old established company. Equipment backed by national advertising.

A manufacturer of paving expansion joints is looking for distributors for northern California territory.

Manufacturer of metal lath, corner beads, channels and reinforcing mesh desires to secure distributors for products in the southwest and middlewest.

Manufacturer of threadless pipe couplings and tees, with rapidly growing business, is seeking additional representatives.

Manufacturer of metal tie and spacer wishes to establish distributing points throughout the country.

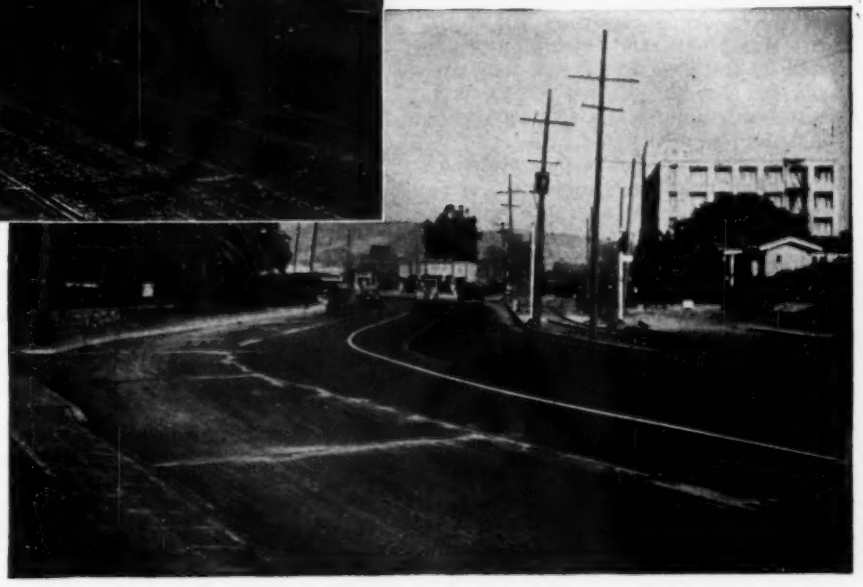
Manufacturer of mechanical spreaders for cover material desires representation by organizations covering entire states. Several desirable states are still open. Number of inquiries now on hand for spreaders require immediate follow up.

Manufacturer of complete line of construction equipment, mixers, saw rigs, plaster and mortar mixers and pumps has an open territory in the state of Maine and is looking for an aggressive distributor to represent him there.

Long established and well-known manufacturer of industrial locomotives wishes to make contacts with qualified distributors. Locomotive line includes steam, gasoline, gas-electric and oil-electric. Supported by national trade journal advertising.

The "Forty-Niners" would blink their eyes —at *these* California roads!

TWO fine sixty-foot California roads, on the outskirts of Los Angeles. The concrete is perfectly and lastingly protected by Carey Elastite Expansion Joint, installed both longitudinally and transversely.



DIFFERENT, aren't they, these concrete Western Coast highways from the rutted "Westward Ho!" trails of the covered wagons? Yes, indeed! Smooth as a table-top, mile after mile. And engineered to *stay* smooth, too—for they are protected by *Carey Elastite Expansion Joint*.

. . . two tough strips of asphalt-saturated felt, with a filler of asphalt and fibre—Carey Elastite Expansion Joint! Preformed—quickly installed in any weather—as easy to handle as a board.

IN every State of the Union, contractors and construction engineers are using and recommending this pioneer, give-and-take "sandwich" joint. For city streets and state highways, for bridges and dams—to protect the concrete against expansion and contraction strains. Have us send you full particulars about Expansion Joint installation.

Carey Elastite EXPANSION JOINT

THE PHILIP CAREY COMPANY, *Lockland*, CINCINNATI, OHIO

Three Miles of Conveyors in Budd Plant

One of the greatest contributors to the successful and efficient manufacture of Budd all-steel automobile bodies is the comprehensiveness and modernity of its elaborate conveyor system, which extends throughout the factory.

In the last year alone, according to Budd officials, more than three miles of new conveyors have been installed, completing a net work which eliminates entirely the problem of hauling large steel body parts through the various stages of manufacturing development.

The type now in use in the Budd factories is a new one known as the monoveyor, and it is said to be much more efficient than any of the methods heretofore used, including trucks, skids, or storage battery tractors. Budd engineers have cooperated with the manufacturers of this device for several years and rapid strides have been made in methods of application and use.

One installation of the monoveyor is 3,320 feet long and carries automobile steel doors from the time they are mere stampings, and operation completed on the first floor, until they are ready for assembly on the fourth floor of another building some distance away.

Another monoveyor carries stampings consisting of a whole side of monopiece automobile body from the first to the fourth floor, through the various periods of its development from a raw piece of steel to the finished product.

The entire system as it now stands involved very large expenditures for experimentation, the cost of drilling holes in floors and sides of buildings, and for the equipment itself.

By the end of this year the Philadelphia Budd plant will be equipped with 20,255 feet of monoveyors, about 4 miles, of which 1796 feet are of the horizontal type, and 1831 feet of special types. This comprises one of the most complete and efficient systems of its kind in the entire world.

Trackson Appointments

The Trackson Co., Milwaukee, announces the appointment of the following new distributors, who will handle Trackson tractor equipment for McCormick-Deering tractors: The Highway Equipment Co., 919 First National Bldg., Columbus, O., for the Columbus territory; Industrial Tractor & Equipment Co., 2702 Spring Grove Ave., Cincinnati, O., for the Cincinnati territory; the Fred D. Marshall Co., Columbia, S. C., for the state of South Carolina; the H. O. Penn Machinery Co., 140th St. and East River, New York City, for the New York City territory; and the Raleigh Road Machinery Co., Raleigh, N. C., for all of North Carolina.

These distributors will handle Trackson crawlers, shovels, cranes, hoists, etc., and will be able to give prompt service on all orders for machines, as well as for repair and replacement parts.

David White, Inc., Buys Wissler Instrument Co.

Two of the leading middle western manufacturers of engineering instruments have joined forces through the purchase of the Wissler Instrument Company by David White Company, Inc.

The White Company manufactures a complete line of engineers' transits and levels, and also surveying instruments for contractors and builders. Drawing instruments are another line in which they specialize. The blueprinting and reproduction departments have recently been enlarged so that excellent service can be given on rush jobs.

The factory of the David White Company is located at Milwaukee, although they have branches in Chicago and Detroit.

Trackson Distributors

Among the new distributors who have been appointed recently to handle Trackson Tractor Equipment for McCormick-Deering tractors is the J. D. Adams Company, Indianapolis, Ind., who will cover the territory included in the Indianapolis, Fort Wayne, Richmond, Terre Haute and Evansville, Ind., branches of the International Harvester Co. and also that of the Louisville, Ky., branch.

McCarthy-Jones & Allen Co., Inc., Nashville, Tenn., have been appointed Trackson distributors for the Nashville territory, and the Option Equipment & Supply Company, R. F. D. No. 6, Mt. Oliver Station, Pittsburgh, Pa., for the Pittsburgh territory.

All of the distributors will handle a complete line of Trackson crawlers, shovels, loaders, bulldozers, cranes, hoists, etc., and will be able to give prompt service on orders for these machines and on repair and replacement parts.

Sterling Motor Declares Dividend

A regular quarterly dividend of 50 cents a share on the preferred, payable April 1 to stockholders of record March 20, was ordered by directors of Sterling Motor Truck Co., Milwaukee. The company reports greatly increased sales thus far during 1930 as compared to corresponding months a year ago. A material increase in the number of stockholders is also reported.

Directors of Budd Wheel Company authorized payment of regular quarterly dividend of 1¾ per cent on $1.75 on the 7 per cent preferred stock and an extra dividend of ¾ per cent on 75c on the same stock. All dividends payable March 31st to holders of record March 10th.

Continental Motors Elects Vice-Presidents

At a recent meeting of the board of directors of the Continental Motors Corporation, Roger Sherman and James H. Ferry, both of Chicago, were elected vice-presidents of the organization. Both men have, for a number of years, been members of the board.

Roger Sherman is a member of the law firm of Tenney, Harding, Sherman and Rogers and has been president of the Illinois Bar Association and has also served as president of the Chicago Bar Association. For several years he was master of the Chancery Court of Chicago.

Jas. H. Ferry has been associated with Continental Motors for many years as a member of the board and is one of its largest individual stockholders.

At the same meeting of the board B. F. Tobin, Jr., was elected treasurer of the company. Mr. Tobin has been connected with Continental since he left college. He has been assistant secretary, secretary and member of the board of directors.

Du Pont Technical Division Holds Annual Meeting

The 14th annual meeting of the Technical Section of the Explosives Department, E. I. du Pont de Nemours & Company, was held recently in the du Pont-Biltmore Hotel, Wilmington, Del. Arthur LaMotte, manager of the section, presided. More than one hundred subjects relating to explosives and their uses in mining, construction and for other industrial purposes were discussed by the eighty du Pont executives and field representatives from all parts of the United States.

J. W. McCoy, general manager of the Explosives Department, addressed the opening session, while L. P. Mahony, director of sales, was the principal speaker at the dinner which followed the close of the three-day meeting.

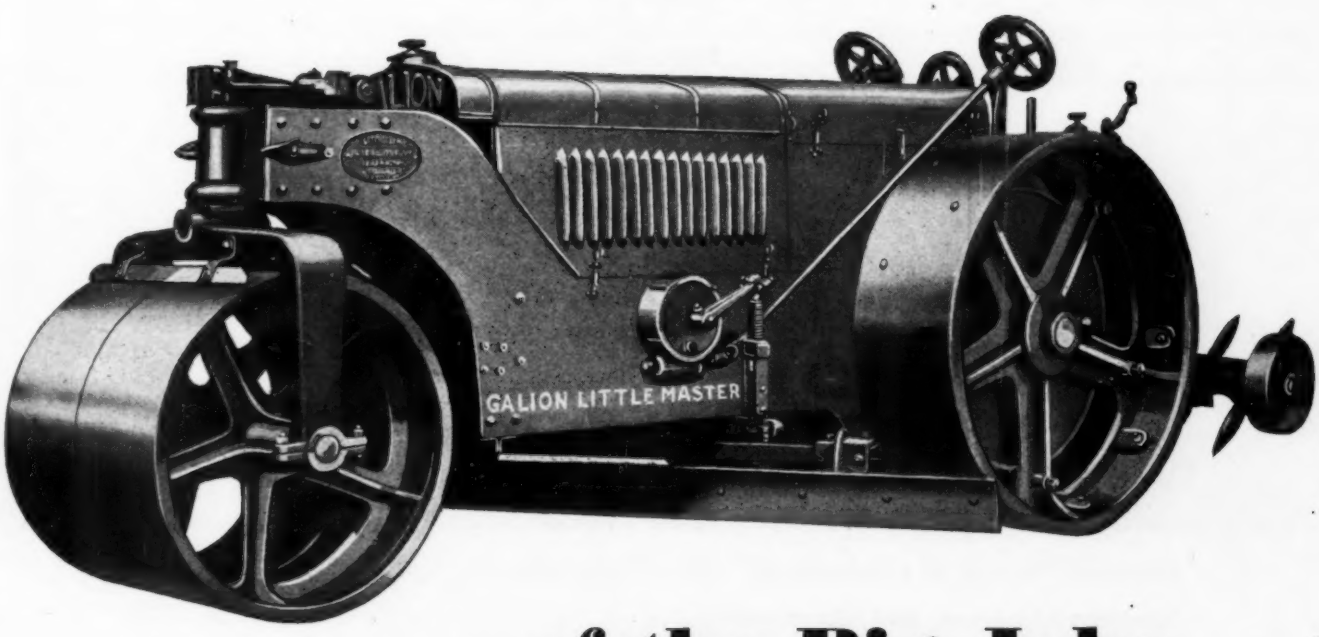
Budd Manufacturing Elects

Directors of Edward G. Budd Manufacturing Company today elected officers. Edward G. Budd, president; Donald Alexander and William J. Meinel, vice presidents; H. A. Coward, secretary; Paul Vens, treasurer; C. W. Messenger and Edward C. Dessalet, assistant-treasurers.

Independent Pneumatic Tool Elects Vice-President

At their annual meeting, March 12, the directors of the Independent Pneumatic Tool Company, 600 West Jackson Boulevard, Chicago, elected Frank B. Hamerly of Aurora, Ill., vice-president, in charge of manufacturing.

a little Master



. . of the Big Jobs

Galion Distributors

W. A. Adams Tractor & Equip. Co., Raleigh, N. C.
R. S. Armstrong & Bro. Co., Atlanta, Ga.
O. B. Avery Co., St. Louis, Mo.
Badger Tractor & Equip. Co., Milwaukee, Wis.
W. D. Banker Road Machy. Co., Memphis, Tenn.
Banks-Miller Supply Co., Hustington, W. Va.
Borchert-Ingersoll, Inc., St. Paul, Minn.
Brown-Fraser & Co., Ltd., Vancouver, B. C.
Dukehart Machy Co., Des Moines, Iowa
Easton Tractor Co., Cambridge, Mass.
Feenaughty Machy. Co., Portland, Ore.
Frankfort Equip. Co., Frankfort, Ky.
Good Roads Machy Co., Inc., New York, N. Y.
Hall Perry Machy. Co., Butte, Mont.
Herd Equip. Co., Oklahoma City, Okla.
Interstate Machy. & Supply Co., Omaha, Nebr.
Jeffrey Mfg. Co. Ltd., Montreal, Que.
Jenison Machy. Co., San Francisco, Cal.
C. H. Jones Co., Salt Lake City, Utah.
Lewis-Patten Co., San Antonio, Texas.
Lewis Tractor & Machinery Co., Fargo, N. D.
Marsh Equip. Co., Colby, Kan.
Miller & Requarth, Springfield, Ill.
Morrow Auto Co., Albuquerque, New Mexico
H. W. Moore Equip. Co., Denver, Colo.
Morrisey Easton Tractor Co., Vicksburg, Miss.
Murphy & Murphy, Little Rock, Ark.
C. T. Patterson Co. Inc., New Orleans, La.
G. C. Phillips Tractor Co. Inc., Birmingham, Ala.
Power Equip. & Service Co., New Haven, Conn.
F. Ronstadt Co., Tuscon, Ariz.
Salina Tractor & Thresher Co., Salina, Kan.
Bert Smith, Enid, Okla.
Smith-Booth-Usher Co., Los Angeles, Cal.
Standard Road Equip. Co., Rockford, Ill.
W. H. Stoutenburg, Penn Yan, N. Y.
Tennessee Tractor Co., Nashville, Tenn.
F. E. Vaughn, LaCrosse, Kan.
Virginia Road Machy. Co., Richmond, Va.
Welch Good Roads Supply Co., Welch, W. Va.

For those who have known and used the Galion Master, the Galion Little Master Roller needs no introduction other than to say . . . that it is like its larger brother in design and construction.

The Little Master embodies, to a degree never before attained in a small roller, the same simple unity, rigidity, strength and handsome appearance found in the Master Roller.

The Little Master uses the same transmission and Twin Disc Clutch that have proved so successful in the famous Galion Master. One piece heavy steel side frame plates . . powerful steel pinion and gear . . and renewable phosphor-bronze bearings for the rear axle are only a few of the features that make this Roller truly the Little Master of big jobs.

A Hercules Model K, 4-cylinder, 4-cycle motor furnishes the power forthe Little Master. Three sizes . . 6, 7 and 8 tons.

There's a Galion Roller for every job. Write the Galion distributor nearest you for bulletins describing them.

The Galion Iron Works & Mfg. Co.

Galion - - - - - - - - - - Ohio

ROADS AND STREETS

H. P. Gillette Editor

Vol. LXX MAY, 1930 No. 5

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Entered as Second Class Matter, January 18, 1930, at the Post Office at Chicago, Illinois, under the Act of March 3, 1879. Published Monthly at 221 E. 20th St., Chicago, Ill. Per copy 25c. Subscription rates $2.00 per year. Copyright, 1930, by Gillette Publishing Company. Publishers of: Engineering and Contracting, Water Works and Sewerage, Roads and Streets, Motive Power, Tiles and Tile Work, Motor Freight, Road and Street Catalog and Data Book, Water Works Catalog and Data Book.

Chicago Office, 221 E. 20th St. Cleveland Office, 953 Leader Bldg. New York Office, 420 Lexington Ave. San Francisco Office, 703 Market St.

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Addresses will be changed as frequently as desired, upon notification; not otherwise. Changes of address should be sent in at least two weeks before the date of the next issue of *Roads and Streets*. In order for them to be effective for that number. Immediate notice should be given of any delay in the receipt of the magazine.